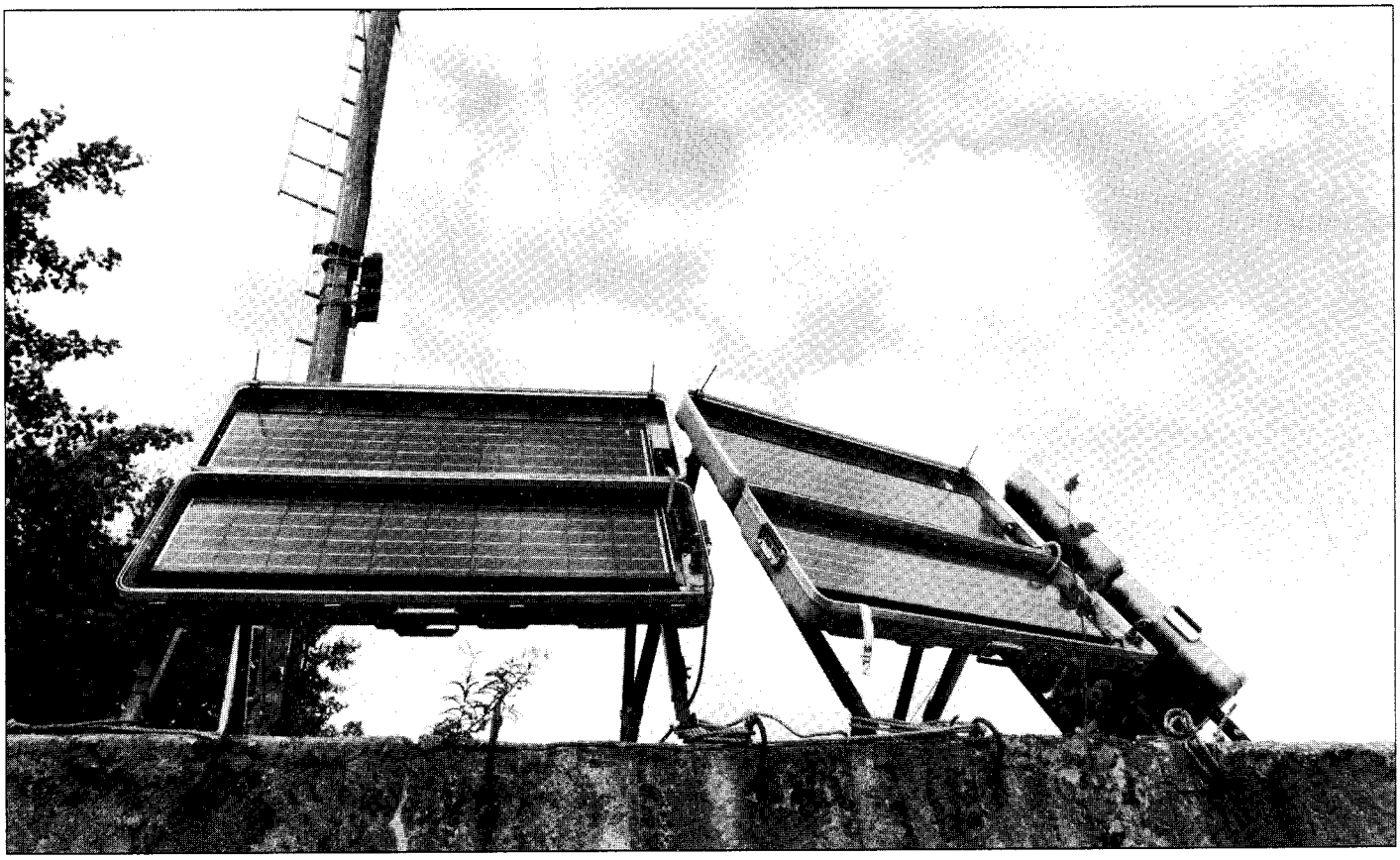
NO. 5, DECEMBER 1994

Acid News



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SOLAR POWER

Sunny future seen

A BRIGHT FUTURE appears to be in sight for the conversion of solar radiation to electricity. Photovoltaic cells spread over a few hundred thousand square kilometres of the world's surface could suffice to supplant the entire consumption of coal, oil, and gas for power production. Although that may seem a vast area to cover, actually it would amount to no more than a few per cent of the earth's deserts.

Solar cells are under rapid development and will not only be cheaper but also more efficient in utilizing the incoming sunlight. In small-scale applications, solar electricity is already a reality in all parts of the world. It can be especially competitive as an alternative to extension of the ordinary grid for providing power to emergency telephones, navigation lights, and lighting for vacation cabins, to name a few examples. In the rural areas of developing countries, where the electricity supply may either be poor or non-existent, solar cells are being used to work lighting systems, pumps, refrigerators, and such like. At current prices, however, not many people can afford solar cells.

There are still a number of problems that remain to be solved if solar energy is to be applied on any large scale. These concern efficiency and storage, as well as cost. Hydrogen may provide a solution for the storage problem (see box p.3). While most of the research around solar power has tended to concentrate on photovoltaic cells, attention is also being directed to solar thermal systems, which recover heat from the sun to drive steam turbines.

One variant of these last is that being exploited by Solel, an Israeli-Belgian company. Here arrays of parabolic troughs are used to focus the solar energy onto pipes containing oil, the heat from which is then used to convert water to superheated steam. The technology was developed by Luz, another Israeli enterprise, which has already built nine power plants in the Mojave Desert in southern California. These plants can together generate 354 megawatts of electricity. Although that is only about 2 per cent of the capacity of the local grid, it amounts to half of the world production of solar power, the rest coming from small photovoltaic systems that usually supply less than 1 megawatt.

The plants in California have troughs about 100 metres long, set in parallel, each containing 224 glass mirrors with a total collecting area of 545 square metres. The troughs are computer-controlled to follow

Continued on page 3

A NEWSLETTER FROM THE SWEDISH NGO SECRETARIAT ON ACID RAIN

Acid News

is a newsletter from the Swedish NGO Secretariat on Acid Rain, whose aim is to provide information on the subjects of acid rain and the acidification of the environment.

Anyone interested in these problems is invited to contact the secretariat. All requests for information or material will be dealt with to the best of our ability. Acid News is distributed free of charge.

In order to fullfill the purpose of Acid News, we need information from everywhere – so if you have read or heard about something that might be of general interest, please write or send a copy to:

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THE SECRETARIAT

The Swedish NGO Secretariat on Acid Rain was formed in 1982 with a board now comprising one representative from each of the following organizations: The Environmental Federation, the Swedish Anglers' National Association, the Swedish Society for Nature Conservation, the Swedish Youth Association for Environmental Studies and Conservation, and the World Wide Fund for Nature Sweden.

The essential aim of the secretariat is to promote awareness of the problems associated with air pollution, and thus, in part as a result of public pressure, to bring about the required reduction of the emissions of air pollutants. The eventual aim is to have those emissions brought down to levels – the so-called critical loads – that the environment can tolerate without suffering damage.

In furtherance of these aims, the secretariat operates as follows, by

- ☐ Keeping under observation political trends and scientific developments.
- ☐ Acting as an information centre, primarily for European environmentalist organizations, but also for the media, authorities, and researchers.
- ☐ Producing and distributing information material.
- ☐ Supporting environmentalist bodies in other countries by various means, both financial and other, in their work towards common ends.
- ☐ Acting as coordinator of the international activities, including lobbying, of European environmentalist organizations, as for instance in connection with the meetings of the bodies responsible for international conventions, such as the United Nations Convention on Long Range Transboundary Air Pollution.
- ☐ Acting as an observer at the proceedings involving international agreements for reducing the emissions of greenhouse gases.

EDITORIAL

Take this first

OUR PLANET'S biodiversity is threatened in many ways – not least through airborne pollution. During the eighties a good deal of attention had been given to the general effects of acidification and the direct ones of gaseous pollutants, in particular low-level ozone. Less attention has been paid on the other hand to the threat from the increasing depositions of nitrogen compounds.

In most terrestrial ecosystems it is the availability of nitrogen that puts a limit to plant growth. Consequently many species have become adapted to areas where the availability is relatively low – and where they can be competitive. In other words, if the supply of nitrogen increases, such species are likely to be displaced by others with a greater liking for nitrogen. Effects of this kind, with changes in the composition of the vegetation, have long been noted in several types of ecosystem.

While the emissions of sulphur have fortunately gone down in Europe during the last few years (see p. 14), no such trend is yet visible for nitrogen compounds: nitrogen oxides and ammonia. Motor vehicles are the outstanding source for emissions of nitrogen oxides, although combustion for generating electricity and heat also contributes quite a lot. As regards ammonia, farming is almost the only source.

An attempt to determine the critical loads for nitrogen, first at a national and then at a European level, has been going on for some time under the UN ECE Convention on Long Range Transboundary Air Pollution. Here account is being taken of the effects of nitrogen in respect of eutrophication as well as acidification. Use is being made both of empirical data – that is, data based either on field observations or laboratory tests – and of computer modelling. The critical levels for ground-level ozone are also being set out.

The resulting maps will be used in the negotiations for a reduction of emissions that are to take place when the 1988 protocol on nitrogen oxides is being revised. Discussions have in fact already started, but because many of the participants want to have all the effects of nitrogen dealt with in a single package, there is a risk of the revision becoming a long-drawn-out process. It may take several years, perhaps until 1997 before the data on ammonia and volatile organic compounds (VOCs) is sufficiently well grounded to be useable in the modelling of scenarios for cost-effective reduction measures.

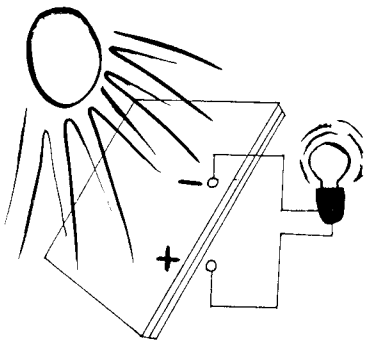
If one considers the amount of nitrogen that is emitted to the atmosphere in Europe, it appears that nitrogen oxides and ammonia are each accountable for about half the total. On a closer look, however, nitrogen oxides turn out to constitute the greatest threat. While both these types of pollutant contribute to acidification and eutrophication, nitrogen oxides are also a key factor in the formation of low-level ozone. Since nitrogen oxides can occur locally in urban areas in exceedingly high concentrations, they are moreover a direct threat to health.

With all this in view, measures to curb emissions of nitrogen oxides should be given priority – instead of being delayed simply because the data on ammonia, VOCs, and ozone is still not completely acceptable for use in negotiations governed by the critical loads approach.

The available figures, many of which are years old but still reliable, show that the emissions of nitrogen oxides need to be reduced by at least 80-90 per cent. Therefore the nations could hardly be going wrong if they decided to at least halve the emissions with the least possible delay. That could be regarded as an intermediate objective which could later be adjusted – and probably distinctly tightened – when better data is forthcoming on ammonia and VOCs.

The equation is quite simple: Lessened emissions mean less damage, and the quicker the emissions are reduced, so much the less will be the damage. The only question is which countries are taking the problem seriously enough and have the courage to press the matter internationally so as to avoid unnecessary dilatoriness in taking steps to reduce emissions.

CHRISTER ÅGREN



© JON SUND

Photovoltaic cell in its basic form consists of two layers of high-quality silicon, one positive, the other negative. Solar radiation falling on the cell liberates negative charges, electrons, which move to the positive layer. The movement creates an electric current which can be used when both sides of the cell are connected to a circuit.

Continued from front page

the sun. To generate 80 MW, the largest plant needs some 900 troughs.

Solel is now planning to build plants that will be a development of the Luz type, among other changes with water instead of oil in the pipes. Among them will be one in Israel, but the company has also set its sights on a 70 MW unit in Australia, either in Queensland or the Northern Territory – the reason being the vicinity to Asia, which is expected to be a key market. There will also be the Olympic Games in Sydney in 2000, which have already been dubbed the "Green Olympics." Solel is pushing solar thermal energy as the most environmentally "friendly" means of supplying the 10 MW that the Olympic village and sports arenas will need.

The Luz system was designed for the desert regions of California, with abundant sunshine and little water vapour. With new selective coatings for the pipes and altered alignments for the troughs, Solel hopes however to extend the geographical range of the technology. David Mills, an Australian physicist who is now in partnership with Solel, believes it will be possible within three years to produce electricity for the equivalent of about 7 cents (US currency) a kWh, and bring the price down to 5.5 cents two years later.

The new selective surfaces will be capable of converting an average of 20 per cent of the solar radiation to electricity throughout the year. Mills is confident that by the year 2000 solar thermal electricity will be competitive over two-thirds of the United States and all of continental Australia and Europe, as well as in the developing countries of Africa, South America, and the tropics.

Another solar thermal system uses an enormous hexagonal dish to concentrate the sun's rays. The largest one of this kind, with an area of 400 square metres, is that belonging to the Australian National University, Canberra. Together with a consortium of power companies, the university is now planning to set up perhaps twenty-eight such dishes at Tennant Creek in the Northern Territory, to supply up to 2 MW of electricity.

The ANU estimates that in desert conditions, the dishes will be able to generate power for as little as 4 cents

Hydrogen as an energy carrier

There are no practical ways of storing electricity on a large scale. Electricity might however be used to produce hydrogen, a high-quality fuel which when burnt gives rise to little in the way of pollution and can be used for driving vehicles and space heating, as well as for producing electricity. Like fossil fuels, too, it can relatively easily be transported.

The raw material is ordinary water. By means of an electric current, say from solar cells, the water molecules are decomposed in an electrolytic process to form hydrogen and oxygen. The hydrogen can then either be compressed for storage or moved away through pipelines.

The residue from combustion consists mainly of water, but also of nitrogen oxides. The amounts of the latter can however be kept in check by burning at a low temperature. A future may lie in the use of fuel cells, where hydrogen is combined with oxygen and the energy so released can be used to generate electricity.

At present hydrogen is too expensive to be able to compete with other fuels. Some way into the 2000s, when solar-cell technology has become more economic, a breakthrough may however come.

ON THE FOLLOWING PAGES

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per kWh. A dish can focus so much light onto a small area as to produce very high temperatures – up to 1500°C compared with 300°C for troughs. It means that the dish technology, unlike the Luz troughs, does not require gas superheating to raise the temperature of the fluid in the pipes.

Although solar thermal technology may turn out to be the winner, it will take at least five years for any system to become really competitive. In the meantime great advances are being made in the field of solar cells.

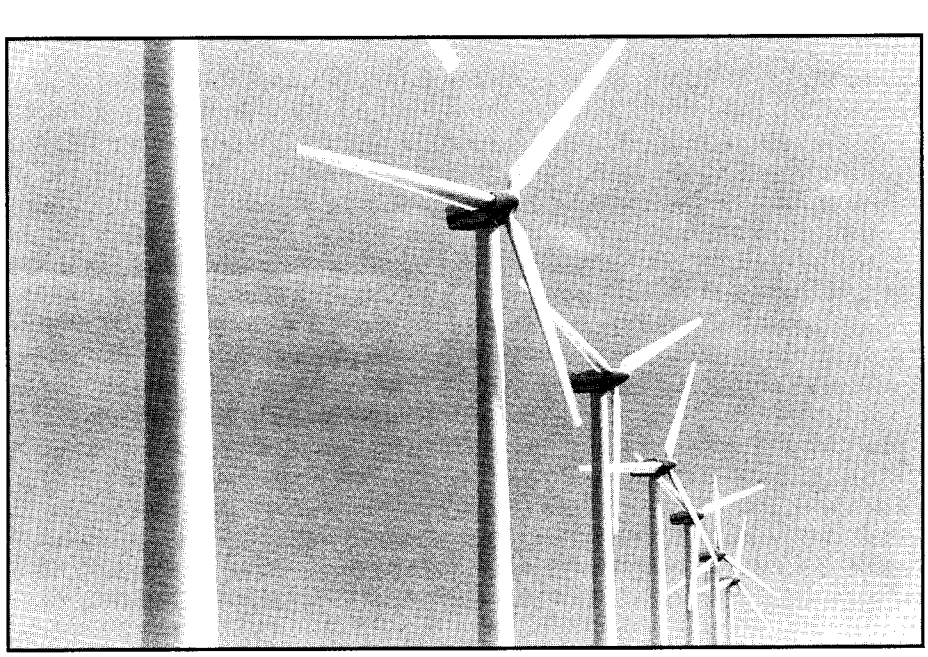
The silicon cells can now convert 23.5 per cent of the incoming radiation to electricity. The silicon is however of very high quality, making the cells expensive, so other ways are being tried. Instead of the two layers of silicon, as in the conventional cells, several thinner layers of low-grade material are being used. Although these new cells are less efficient, the electricity produced is much cheaper. Martin Green, who is working on solar cells at the University of New South Wales, Sydney, boldly claims that in about ten years the cost of electricity, using the new cells, could be cut by 80 per cent, from today's 30-40 cents per kWh to 5 to 8 cents.

Another variant of the solar cell that shows promise is the so-called CIS type, embodying a combination of copper, indium, and selenium laid in thin layers, much the same way as in making a mirror. With such cells the energy recovery time – that is, the time it takes to recover the amount of energy that goes to manufacturing them – is less than half a year, as compared with about five years in the case of the monocrystalline silicon cells.

What will be the best ways of producing electricity from sunlight should become clearer during the next ten years. Stricter environmental standards and rising prices for fossil fuels are in any case likely to lead to an increased commercial interest in solar energy. Sunshine costs nothing, and is estimated to be available for quite five billion years.

PER ELVINGSON

For the information concerning Australia, the writer has drawn on an article by Ian Anderson in *New Scientist*, July 2, 1994.



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Wind power

IN MANY PARTS OF BRITAIN wind power is running into opposition. Controversy came to a head in Wales, where there are half of the country's wind turbines, after a local resident had complained of the noise from the wind farm at Llandinam, Europe's largest. This led the House of Commons Select Committee on Welsh Affairs to start investigating. From its hearings it has however emerged that many people consider the noise from the turbines to be less irritating than their "visual impact."

In an attempt to get around this dilemma, landscape architects have suggested arranging the turbines in clusters of 10-20, which would be less conspicuous than having them in long lines. But others reply that the many small wind farms would extend the visual impact over a far wider area than a few big ones.

Visually polluting though it may be, wind power is nevertheless an exceedingly clean form. As protagonists point out, acid rain from the burning of coal in traditional power plants is already destroying whole areas of Britain. Some claim that 10 per cent of the country's electricity needs could be covered by wind power – so saving 30 million tons of carbon dioxide a year, or almost all of the 33 million tons promised under the Climate Convention. But that would call for 300 big new wind farms, spread over 1200 square kilometres of the countryside.

And so the debate goes on. While rural conservationists would like to see a great improvement in energy efficiency as the solution, more globally-minded environmentalists such as Friends of the Earth argue that electricity has to be generated anyway, and that wind power is the better alternative. They believe wind power might be more acceptable if something like the Danish system were adopted in Britain – with a lot of small generating units, most of them owned locally.

In any case, surveys have shown that most of the people living near wind farms in Britain do not find them especially disturbing.

Source: **New Scientist**, July 16, 1994.

Denmark

It seems that the more wind power is installed in Denmark, the more people like it. In a poll in 1993, 82 per cent of those interviewed thought still more electricity should be produced from wind turbines, as against 77 per cent three years earlier. Moreover three-quarters declared themselves willing to pay an extra 10 per cent for wind-generated electricity. Their answers also refuted the supposition that only people living far from the turbines can be expected to tolerate them – in fact those having some within sight of their home, school, or workplace were the least inclined to worry about their effects on the landscape.

Source: **Vind 3**, Tore Wizelius, Larson förlag 1994.

Ups and downs in trends

EVERY YEAR the trends for various key environmental indicators are published in *Vital Signs* from the World Watch Institute in Washington DC. Here follow extracts concerning the emissions of carbon, sulphur, and nitrogen oxides.

CARBON DIOXIDE. During 1993, according to preliminary estimates, 5.9 billion tons of carbon were released into the atmosphere, in the form of carbon dioxide, as a result of the burning of fossil fuels. Although marking a slight fall from 1992, this in effect amounts to the continuation of a level trend since 1989. Deforestation added to the carbon from the burning of fossil fuel by releasing an estimated one to two billion more tons. This means that the total emissions of carbon dioxide, the major greenhouse gas, are now taking place at a rate that is two to three times faster than the world's oceans and forests can absorb, and so are leading to a steady increase in the overall atmospheric concentrations of this gas.

The emissions of other greenhouse gases are thought to add the equivalent of another four billion tons of carbon to the atmosphere each year as potential for global warming.

The current plateau in global emissions can be explained by two short-term trends. On the one hand there is the economic recession in the "western" industrialized countries, accompanied by an even greater fall-off in the former Soviet bloc. In the latter, carbon emissions had dropped in 1993 to 810 million tons, a decline of 26 per cent since 1988.

On the other hand emissions in the rapidly industrializing countries of Asia have continued to rise, sometimes at double-digit rates. Seeing that the use of coal is greatly increasing in many of the developing countries, while the retreat in eastern Europe is on the way to becoming reversed, a resumption of the global rise may soon be expected, probably at a rate of one to two per cent a year during the remainder of the decade.

The rates of emission continue to show a wide variation from country to country. Per capita in 1992 they were 5.4 tons in the United States, as against 4.0 in Russia, 3.1 in Germany, 2.4 in Japan, and 0.6 tons in China. The responsibility for combating global warming will lie mainly with the industrialized countries, including those of the former eastern bloc, which with 22 per cent of the world's population account for 68 per cent of the carbon emissions.

SULPHUR AND NITROGEN OXIDES. In 1991 the sulphur emitted to the atmosphere in the form of sulphur dioxide, again from the burning of fossil fuels, amounted to about 70 million tons. At the same time, and from the same source, some 27 million tons of nitrogen were released as nitrogen oxides. A further 10 million tons or so of sulphur came from other industrial processes, and 6-12 million tons of nitrogen were added to the atmosphere as a result of the burning of forests and other biomass. The emissions from all sources can thus be estimated to have been 80 million tons of sulphur as well as 33-39 tons of nitrogen.

Coal burning constitutes the largest source of sulphur emissions, although there will also be emissions from the burning of oil, smelting of metals, and other industrial processes. The emissions of nitrogen oxides come mainly from transportation, power generation, and industrial engines. The rise in both of these pollutants has however been slowed through the use of cleaner technologies and fuels – with particular success as regards the emissions of sulphur. Since 1980 the industrialized countries as a whole have been able to cut their emissions by almost a half. The emissions of nitrogen oxides are on the other hand now about 15 per cent higher.

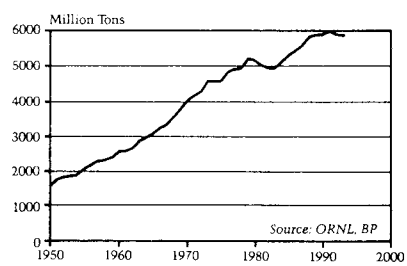
The improvement in sulphur emissions is however likely to be more than offset as economic growth leads to an increased use of energy in the developing countries, since they often lack clean technologies and rely heavily on coal. While the emissions of sulphur have been decreasing in the United States since the early seventies, those in China have steadily risen. In 1970 the United States was emitting 15 million tons, as against China's five. Around 1990 however, both countries were emitting about the same amounts, or 11 million tons.

Before its breakup, the emissions of sulphur in the Soviet Union had risen to about 13 million tons, but have since fallen to under 6 million tons. No other countries approach the emissions of these three giants.

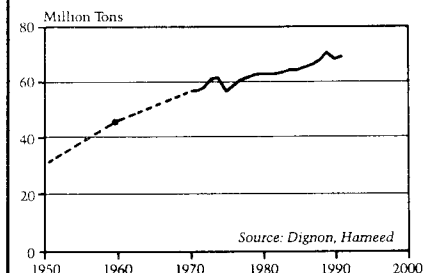
The largest producer of nitrogen pollutants is the United States, followed by the Soviet Union countries, with China as a distant third.

Vital signs: the trends that are shaping our future. Published annually by the World Watch Institute, 1776 Massachusetts Ave., NW, Washington DC, 20036-1904, USA.

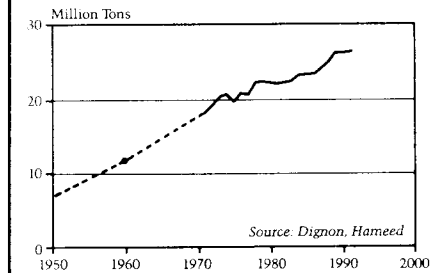
World carbon emissions from burning of fossil fuels.

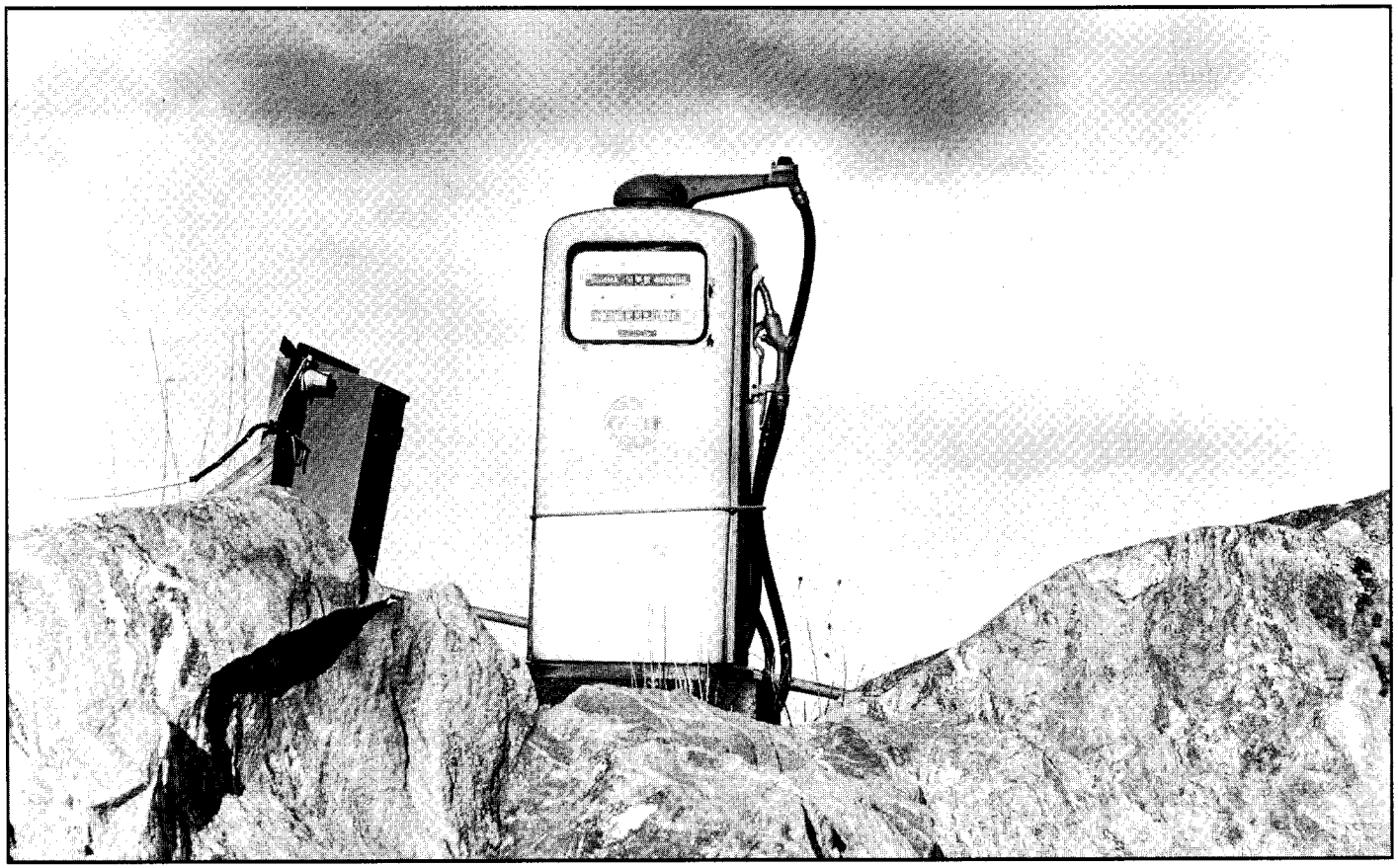


World sulphur emissions from burning of fossil fuels.



World nitrogen emissions from burning of fossil fuels.





SVEN ÅNGERMARK

TRANSPORTATION FUELS

Exploring the alternatives

AS LONG AS PETROLEUM remains the primary fuel for transportation, it will not be possible, even with the strictest emission standards, to significantly reduce pollution from motor vehicles. The increase in traffic will prevent it. It will therefore be an urgent necessity, says the OECD in a recent report, to develop alternative forms of energy for transportation.

Taking improved air quality, reduced emissions of greenhouse gases, and less dependence on petroleum as the main aims, the OECD study explores five so-called pathways. These are biomass fuels, methanol from natural gas and coal, methane fuels, hydrogen, and electricity – including fuel cells, which amount to a combination of hydrogen and electric-vehicle technology. The impediments, and the possibilities for new fuels to force their way onto the market, are also examined.

Examination shows the various possibilities to vary widely. The OECD sees however no single option as obviously superior – any choice depending on which problem one wants to tackle first. If the main concern is for national self-sufficiency and independence, the natural course would be to rely on domestic resources. If economic efficiency, measured by conventional market indicators, is held to be the most important, then almost all the alternatives to petroleum are ruled out.

Long-term aim should be the creation of a sustainable transport system

The greatest short-term improvements in air quality can be gained by the use either of natural gas or liquefied petroleum gas (LPG), but also from using methanol or electricity from natural gas and renewable feedstocks. If long-term environmental quality is to take precedence, and advances in research should make the relevant technologies feasible, then it might be better to have vehicles driven by non-fossil fuels, hydrogen, electricity or fuel cells.

If the avoidance of global warming is the most important concern, on the other hand, the only short-term or mid-term option would, according to the OECD, be a dramatic reduction in the overall consumption of fuels. With advances in research, more long-term options should be available. The best would be electric vehicles powered by batteries or fuel cells (if they can be had), with non-fossil energy as the initial source.

Only negligible amounts of greenhouse gases would be emitted, too, from internal-combustion engines using hydrogen made from water by non-fossil generated power. Vehicles driven by alcohol or gas from woody biomass would also emit very little in the way of greenhouse gases – although biomass cultivation requires careful soil management, and can also give rise to greenhouse-gas emissions from the soil and in the production of fuels. The table summarizes the differences in emissions when

alternative fuels are compared with petrol for the full fuel cycle.

It is important, the report points out, for governments to resolve the start-up dilemma when trying to enforce the use of a new fuel or fuels – by coordinating vehicle manufacture and the distribution and production of fuel. It also discusses various policy tools, such as emission standards, production mandates, market incentives, and combinations of market and command-and-control approaches.

Tighter standards are regarded as theoretically attractive, since they allow manufacturers to select the least costly alternative for achievement of the desired aim. Production mandates might however give quicker results. In California for instance the big car makers must, by 1998, have at least 2 per cent of their output in the form of zero-emission vehicles. It is thought that this requirement will have a great effect on vehicle development.

Economic incentives may also be needed to get things moving. A straightforward and economically attractive way, according to the OECD, would be to raise the tax on petroleum fuels so as to reflect the value of the damage caused by the pollution from road traffic. Another option might be to set the price of petrol high enough to make alternative fuels competitive – although the disadvantages in these cases would be the difficulty of increasing the tax in many countries, and the possibility that the difference in price between petrol and alternative fuels might not be sufficient. Some solution might however be found in a fiscal arrangement that is entirely neutral.

The strategy favoured by the OECD for a transition period would be that each country should, as a first step, monitor and evaluate four different options for light-duty vehicles, these being the use of natural gas, LPG, methanol, and electric propulsion. As regards heavy-duty vehicles, it urges the "aggressive" pursuance of developments, particularly for natural gas, LPG, and methanol – since these fuels can provide major benefits in respect of emissions.

Then as a mid-term aim the organization proposes that member countries should start introducing one or more of the above options, thus making for increased diversity in the market for transportation fuel. The long-term aim should be the creation of a sustainable transport system, with vehicles driven by non-fossil-generated electricity, hydrogen, and biomass-based alcohol fuels. Essential in every case will however be a reduction in the overall demand for fuels for transportation.

PER ELVINGSON

Changes in emissions of greenhouse gases from vehicles using alternative fuels as compared with a petrol-driven vehicle. Full-cycle emissions in CO_2 equivalent; g/km.

Propulsion by	Change in per cent, CO_2 equivalent
Fuel cells *(hydrogen from solar power)*	-90 to -85
Ethanol from wood *(cellulose)*	-75 to -40
Hydrogen with nuclear energy	-70 to -10
Electricity *(from natural gas plant)*	-50 to -25
Liquefied petroleum gases	-30 to -10
Electricity *(from current US power mix)*	-25 to +5
Compressed natural gas (CNG)	-21 to +5
Methanol from natural gas	-15 to +5
Petrol	no change
Electricity *(from new coal plant)*	0 to +10
Ethanol from wheat *(coal-fired distillation)*	-20 to +30
Methanol from coal	+30 to +70

Choosing an alternative transportation fuel – air pollution and greenhouse gas impacts. 1993. 150 pp. US$38,00. Available from OECD, 2 Rue André-Pascal, 75775 Paris Cedex 16, France.

OECD: Organization for Economic Cooperation and Development, with twenty-five member countries, mostly in Western Europe and North America.

See also articles on alternative fuels in Acid News 3/93, pp. 12-15.

Where they are used

As yet, barely 2 per cent of the world's 500 million cars run on anything but petrol or diesel fuel. But the trend is nevertheless upwards. The most used alternative fuel at present is LPG, liquid petroleum gas, followed by ethanol, natural gas, and methanol.

LPG is most at home in Italy, Japan, the Netherlands, Australia, and North America.

ETHANOL is most widespread in Brazil, where there are 99 per cent of the world's ethanol-driven vehicles. But the use is increasing in Sweden as well as in the United States. Ford, General Motors, and Chrysler make Flexible Fuel Vehicles that can run both on petrol and alcohol (ethanol or methanol). Sweden's Scania is the world leader as a maker of ethanol-driven buses.

METHANOL, which was long to the fore, is now in a decline for reasons such as high cost, little improvement as regards emissions, excessive engine wear. While still popular in Japan and California, it is regarded with scepticism elsewhere.

NATURAL GAS shows the most marked upward trend of all alternative fuels, with programs under way for the development of suitable vehicles in forty-three countries. The United States is planning to have 20 million vehicles running on natural gas by the year 2010, which will mean 10 per cent of its whole vehicle fleet (the proportion in 1993 was less than one in a thousand).

The fastest growing markets are however Argentina, Australia, Great Britain, and several countries of southeast Asia. In Japan both car makers and gas producers have strong development programs in progress. The largest single order so far for buses driven by natural gas has come from Sydney, Australia, where delivery of the 250 vehicles from Scania has already started.

BIOGAS, like natural gas, consists of methane – the difference being that while natural gas is a fossil fuel, biogas comes from renewable sources. Engine design is in any case unaffected. Biogas is produced from the decomposition of organic matter, such as sewage sludge, but it can also be salvaged from waste dumps. Linköping in Sweden, Tours in France, and Colorado Springs in the United States all have buses running on biogas.

ELECTRIC CARS are the hope of the future. Although the technology is still rather primitive, development is likely to be considerably hastened by mandatory requirements in California (see AN 4/94, p.12).

Source: **Trafik & Miljö**, No. 1, 1994. Published by Gröna Bilister, an organization recently formed in Sweden for environmentally minded motorists.

Still no improvement

THE OUTLOOK for Europe's forests remains unencouraging. No discernible improvement over the previous year can be found in the report on the survey for 1993, which has just come out. Of a total sample of 102,800 trees, 22.6 per cent had suffered more than 25-per-cent defoliation, putting them in the damaged class.

Assessments of forest damage have been made in Europe by a common method since 1986. The last survey included thirty-two countries and covered a total area of 169 million hectares, or about two-thirds of the whole forested area of Europe. Alongside the country-by-country surveys, a transnational one has been carried out since 1987, with an ever increasing number of participating countries. This latter involves the appraisement of a number of site parameters on sample plots in a 16x16 kilometre grid. Where the national grid is denser, as it is in several countries, the plots in the transnational grid amount to a subsample.

On each plot sample trees are assessed in accordance with a five-class system:

Class 0	0-10%	defoliation	none
Class 1	11-25%	"	slight
Class 2	25-60%	"	moderate
Class 3	60%–	"	severe
Class 4	100%	"	(dead)

The extent of defoliation is used as a means showing the general state of health of the trees. Class 1 is regarded more as a warning stage than an indication of reduced vitality. In 1993, 20.4 per cent of all the broadleaved trees fell into Classes 2-4, and 23.9 per cent of the conifers. In other words, there was little or no change from the previous year – although direct comparison is difficult on account of an alteration in the size of the survey area.

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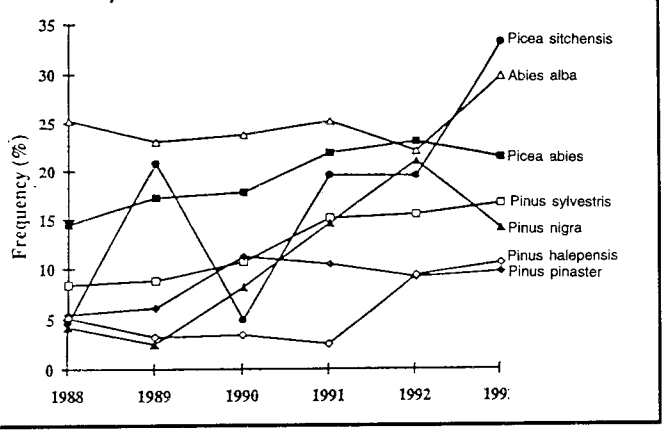
The table and map show the trend for each country during the period from 1986 to 1993. Once again, the areas with the greatest proportion of damaged trees were in Central Europe, where forests covering several thousand hectares of high mountain land were among the worst affected. In general it can be said that aged trees and trees standing on high ground will be most at risk, although it now seems that defoliation is again tending to increase in younger stands too.

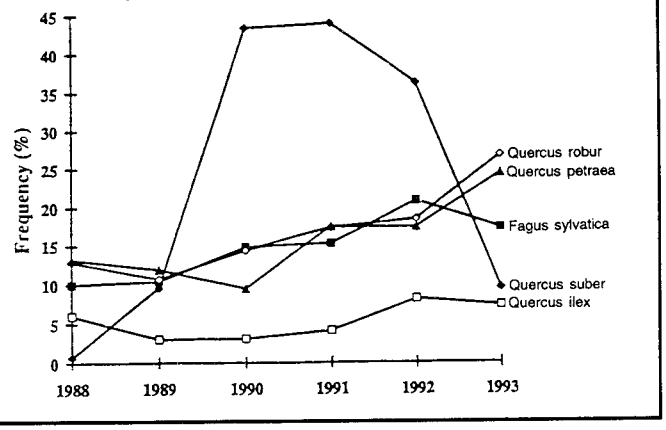
As might be expected, the extent of damage can vary greatly from one year to another – since the factors affecting the trees' vitality, such as drought, wind, frost, and air pollution, will also vary. The apparent improvement recorded for the United Kingdom in the latest survey is however due to a change of method. Previously the trees there were compared with photographs of fully foliated ones growing under ideal conditions. From now on the photographs will be of trees growing under the same conditions as those being assessed. This will facilitate comparison with the results from other countries.

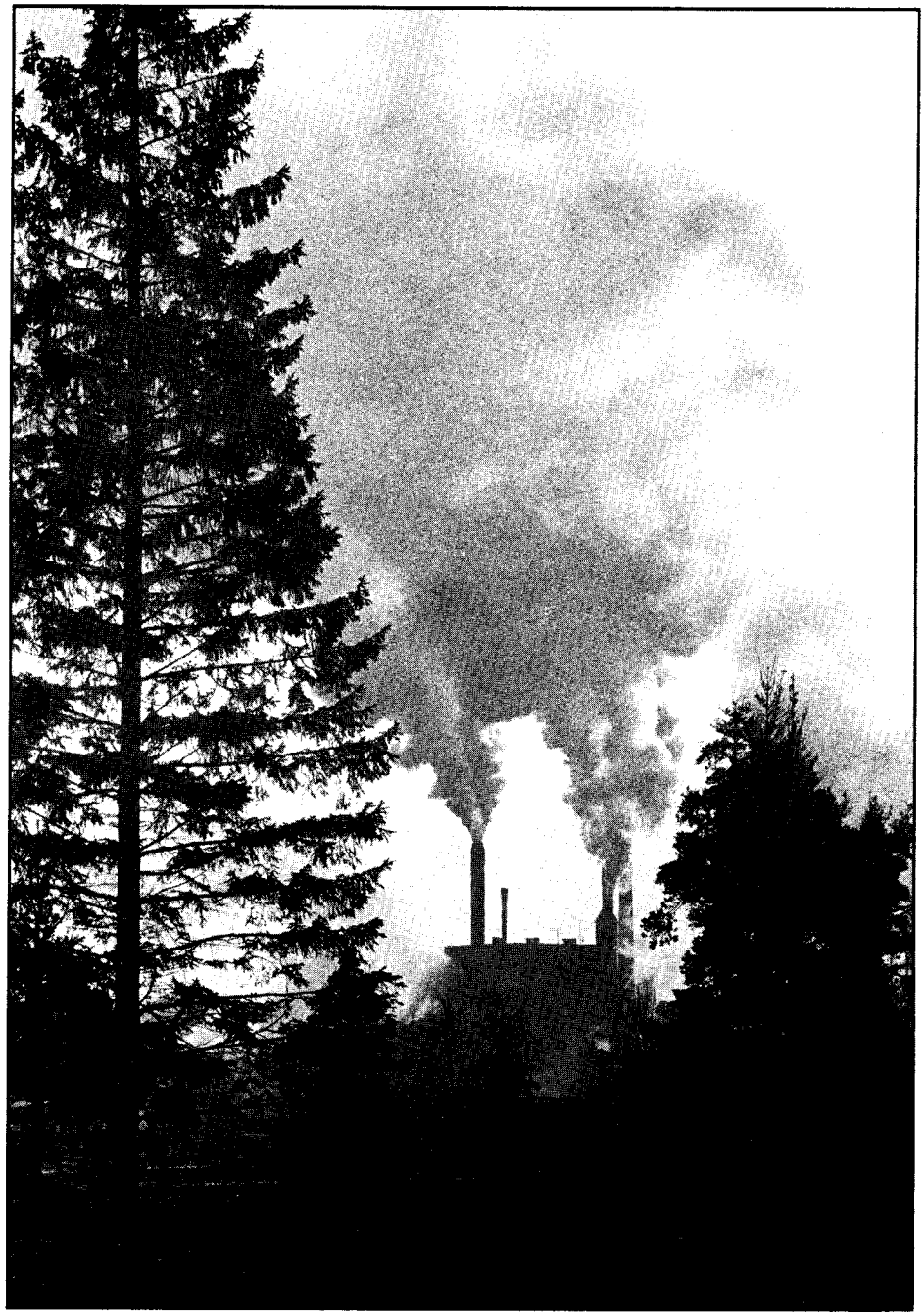
Every year since 1988 the trends have been observed in twelve

Change in defoliation for coniferous trees (defoliation classes 2-4) common to 1988-1993.



Change in defoliation for broadleaved trees (defoliation classes 2-4) common to 1988-1993.





Environmental Factsheet
No. 5, December 1994

Previous factsheets in the series:
No. 1 Forest Damage in Europe (December 1992)
No.2 Critical Loads (February 1993)
No. 3 The UN ECE Convention (April 1993)
No.4 Climate Change (October 1993)

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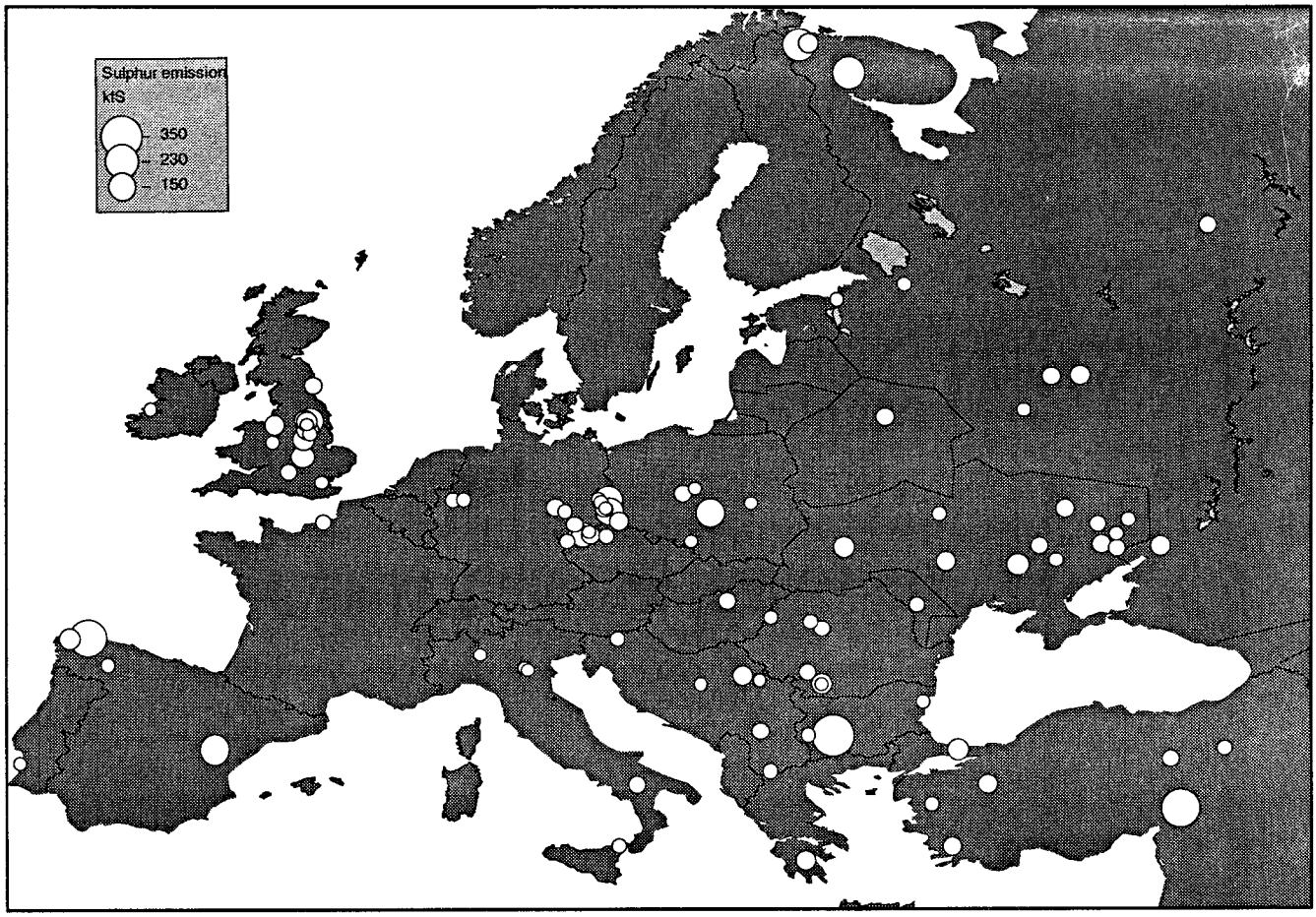
The Swedish Youth Association for Environmental Studies and Conservation

The 100 worst emitters

A RECENT STUDY* HAS SHOWN that a greater part of the emissions of sulphur dioxide in Europe comes from a relatively small number of sources. The hundred worst ones are responsible for almost half the total.

The study covered forty or so countries, including several that have been or still are in a state of radical change, both political and economic. Most of the emission data relates to the period from 1990 to 1992. As a result of the downturn in production from heavy industry in eastern Europe, combined with a shift to natural gas and imported coal in some western countries, major changes are occurring in emission patterns. And because of these changes, the data may not always reflect the actual situation



now, in 1994. Moreover the rapid changes make it difficult to compare, for instance, the information from the study database with the emission data from the United Nations Economic Commission for Europe (UN ECE).

The emissions come from four sources: power stations, industrial plants, oil refineries, and district heating installations. Since there was no database covering all of them, information had to be obtained in various ways in order to be able to pinpoint the sources and estimate their emissions. Among the means employed were questionnaires to utilities and government institutions.

The study not only revealed the hundred worst polluters, but also enabled a database to be built up with information on more than a thousand point sources. A map (above) could be made, too, showing the location of the hundred worst emitters.

About 80 per cent of the man-made emissions of sulphur in Europe were shown to come from the one thousand point sources mentioned, the hundred worst ones alone emitting 42 per cent of the total. Of that hundred, ninety-three are power stations, together with three smelters, two petroleum refineries, a blast furnace producing pig iron, and one manufacturing plant. In the report, these hundred have been ranged according to the size of their emissions and the country of their location.

Since the ninety-three power stations are all fired with fossil fuel, estimates have also been made of their emissions of carbon dioxide. Expressed as carbon, these amounted altogether to 198 million tons.

Considered per ton of reduced pollutant, it is often cheaper – assuming the use of conventional technology for flue-gas desulphurization – to retrofit large plants rather than small ones, and by concentrating on large plants, emissions could be brought down quickly and cost-effectively. This should make it the prime aim when formulating strategies.

It may at least be of theoretical interest to make a rough estimate of the cost of bringing about an improvement by installing modern flue-gas desulphurization equipment at the hundred biggest sources of emission – since that should give some idea of the upper limit to the actual cost of emission control.

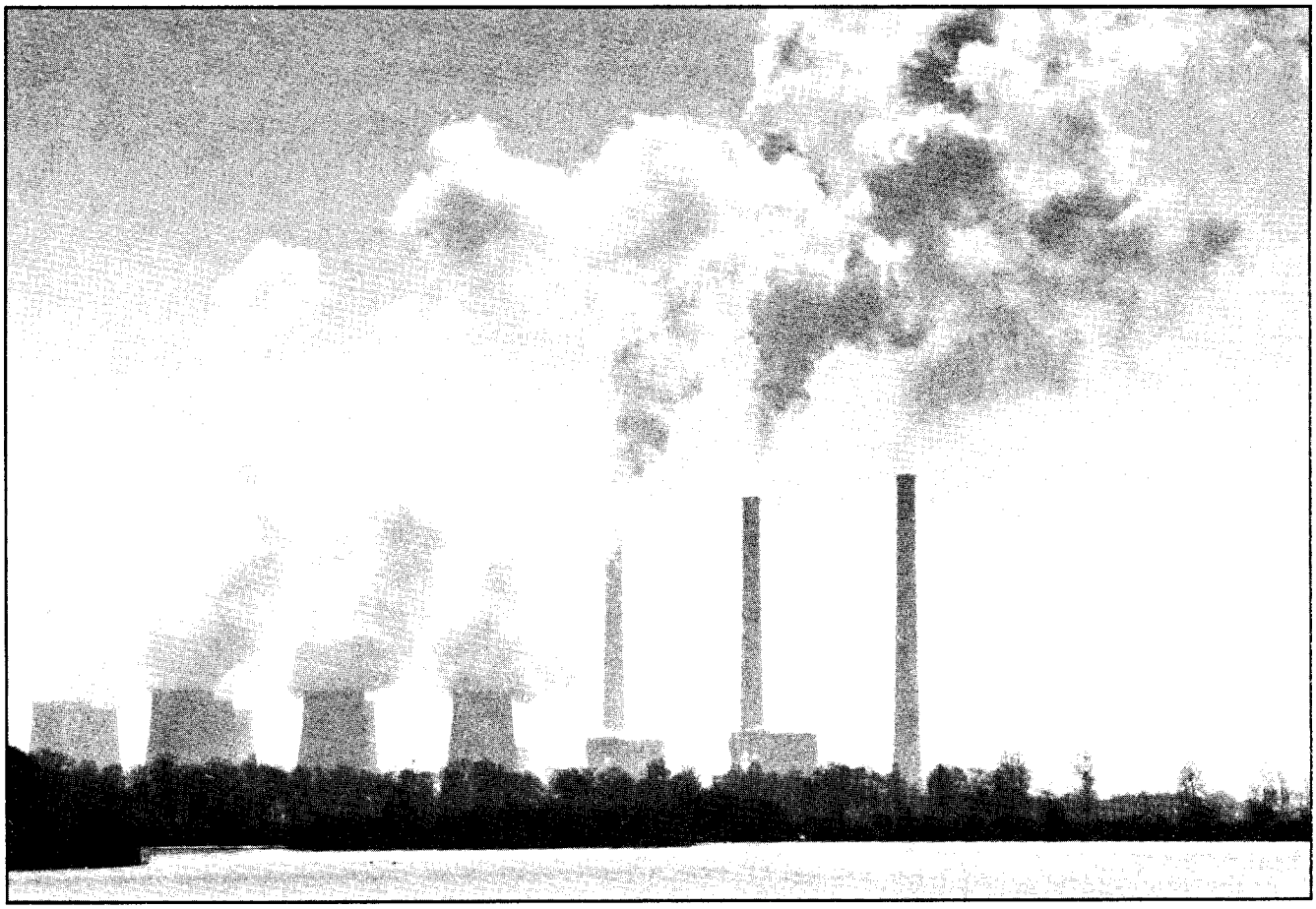
The ninety-three power stations in the "big hundred" have a combined electrical capacity of 138 gigawatts. The capital cost of equipping them for flue-gas desulphurization would amount to US$30 billion. The reduction of sulphur emissions would be about 6.2 million tons, or some 38 per cent of the European aggregate. The total annual cost would be about US$4.3 billion.

Often, however, conventional end-of-pipe measures are neither the best nor the cheapest option for emission control. This is especially

The hundred largest European emitters of sulphur

	Name of plant	Type	Location	Emission (ton S)
1.	Maritsa East	PS	Bulgaria	350,000
2.	Afsin-Elbistan	PS	Turkey	288,000
3.	Puentes (As Pontes)	PS	Spain	271,000
4.	Montsegorsk	Sm	Russia	212,000
5.	Nikel	Sm	Russia	211,000
6.	Teruel	PS	Spain	183,000
7.	Belchatow	PS	Poland	168,000
8.	Jänschwalde	PS	Germany	157,000
9.	Boxberg	PS	Germany	149,000
10.	Prunerov	PS	Czech Rep.	137,000
11.	Drax	PS	United Kingdom	132,000
12.	Cottam	PS	United Kingdom	98,000
13.	Tusimice	PS	Czech Rep.	98,000
14.	Krivorozhskaya	PS	Ukraine	95,000
15.	Burshtynskaya	PS	Ukraine	92,000
16.	Ratcliffe-on-Soar	PS	United Kingdom	90,000
17.	Meirama	PS	Spain	90,000
18.	Yenikoy (Yentes)	PS	Turkey	89,000
19.	Ferrybridge	PS	United Kingdom	86,000
20.	West Burton	PS	United Kingdom	85,000
21.	Fiddler's Ferry	PS	United Kingdom	80,000
22.	Novocherkasskaya	PS	Russia	80,000
23.	Lodyzhinskaya	PS	Ukraine	80,000
24.	Isalnita	PS	Romania	79,000
25.	Zapoljarnyj	Sm	Russia	79,000
26.	Nikola Tesla	PS	Yugoslavia	78,000
27.	Ryazanskaya	PS	Russia	76,000
28.	Megalopolis	PS	Greece	76,000
29.	Eggborough	PS	United Kingdom	73,000
30.	Irini	PS	Greece	72,000
31.	Turow	PS	Poland	72,000
32.	Seyitomer (Somtes)	PS	Turkey	72,000
33.	Zmiyevskaya	PS	Ukraine	70,000
34.	Kurakhovskaya	PS	Ukraine	69,000
35.	Yatagan (Yates)	PS	Turkey	68,000
36.	Lukomyl	PS	Russia	68,000
37.	Thierbach	PS	Germany	65,000
38.	Kashiri	PS	Russia	64,000
39.	Pocerady	PS	Czech Rep.	63,000
40.	Lippendorf (Bohlen)	PS	Germany	63,000
41.	Matra	PS	Hungary	60,000
42.	Blyth	PS	United Kingdom	60,000
43.	Starobeshevo	PS	Ukraine	58,000
44.	Pridneprovskaya	PS	Ukraine	57,000
45.	Brindisi Sud	PS	Italy	57,000
46.	Kangal	PS	Turkey	56,000
47.	Zuevskaya	PS	Ukraine	55,000
48.	Adamow	PS	Poland	55,000
49.	Kosovo	PS	Yugoslavia	54,000
50.	Hagenwerder	PS	Germany	54,000
51.	Cherepetskaya	PS	Russia	53,000
52.	Kremikovtsi	PI	Bulgaria	53,000
53.	Didcot	PS	United Kingdom	51,000
54.	Chemnitz	PS	Germany	51,000
55.	Ludus	PS	Romania	51,000
56.	Porcheville	PS	France	50,000
57.	Slavyanskaya	PS	Ukraine	49,000
58.	Moldavia	PS	Moldavia	47,000
59.	Fortuna	PS	Germany	47,000
60.	Bitola	PS	Macedonia	46,000
61.	Luganskaya	PS	Ukraine	44,000
62.	Melnik	PS	Czech Rep.	44,000
63.	Turceni	PS	Romania	43,000
64.	Mintia	PS	Romania	43,000
65.	Soma	PS	Turkey	43,000
66.	Tisova	PS	Czech Rep.	43,000
67.	Milazzo	Ref	Italy	43,000
68.	Bobovdol	PS	Bulgaria	43,000
69.	Uglegorskaya	PS	Ukraine	42,000
70.	Sostanj	PS	Slovenia	42,000
71.	Compostilla	PS	Spain	42,000
72.	Tripolskaya	PS	Ukraine	41,000
73.	Gerstein	PS	Germany	41,000
74.	Lubbenau	PS	Germany	41,000
75.	Belovskaya	PS	Russia	41,000
76.	Zaporozhye	PS	Ukraine	41,000
77.	Kirishi	PS	Russia	40,000
78.	High Marnham	PS	United Kingdom	39,000
79.	Espenhaim	PS	Germany	39,000
80.	Rosanno	PS	Italy	38,000
81.	Oradea	PS	Romania	38,000
82.	Vetschau	PS	Germany	38,000
83.	Varna	PS	Bulgaria	38,000
84.	Balti	PS	Estonia	37,000
85.	Ironbridge	PS	United Kingdom	37,000
86.	Tuzla	PS	Yugoslavia	37,000
87.	Sines	PS	Portugal	36,000
88.	Rovinari	PS	Romania	35,000
89.	Schwarze Pumpe	PS	Germany	35,000
90.	Moneypoint	PS	Ireland	34,000
91.	Kingsnorth	PS	United Kingdom	34,000
92.	MZRP Plock	Ref	Poland	34,000
93.	Drmno	PS	Yugoslavia	33,000
94.	Kozienice	PS	Poland	33,000
95.	Chemopetrol	Pro	Slovakia	33,000
96.	Rybnik	PS	Poland	33,000
97.	Ostiglia	PS	Italy	32,000
98.	La Casella	PS	Italy	32,000
99.	Sermide	PS	Italy	32,000
100.	Thorpe Marsh	PS	United Kingdom	31,000

PS = power station, PI = pig iron plant, Pro = process emissions, Ref = refinery, Sm = smelter



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Eighth among the worst: the Jänschwalde power station in eastern Germany.

so in the case of older installations that are likely to be shortly closed down. Other measures, such as making more efficient use of energy, can lead both to a direct reduction of emissions and a more rapid closure of plants.

A change of fuel – for example, from high-sulphur coal or oil to low-sulphur kinds, or to gas or biofuel – offers another possibility for reducing, quickly and cheaply, the emissions from existing plants.

Yet another option is to replace old, polluting plants with new, more efficient and less-polluting ones. If conventional fossil fuels (coal, oil, natural gas) still had to be used, reduction of the emissions of sulphur and nitrogen oxides could be secured by adopting the best available techniques.

Preferably, however, renewable sources of energy should, to the largest extent possible, be taken into use instead.

* **Sulphur emission from large point sources in Europe.** Second revised edition, November 1994. By Mark Barrett and Rodri Protheroe, Pollen Consultancy, Colchester, England. Can be had from the publishers, the Swedish NGO Secretariat on Acid Rain, Box 245, S-401 24 Göteborg, Sweden.

species of common sample trees, some 28,000 trees in all. As will be seen from the two charts, the most obvious increase in damage among conifers occurred in Sitka spruce *(Picea sitchensis)*, probably as a result of insect attack. But fir *(Abies alba)*, Norway spruce *(Picea abies)*, and Scots pine *(Pinus sylvestris)* have shown a gradual increase in damage, too, since 1988. Among the broadleaved trees, cork oak *(Quercus suber)*, which until recently was enormously damaged, is beginning to show an improvement. In other broadleaved species the damage continues however to increase.

It is difficult, under the present method of survey, to draw any conclusions as to the causes of damage. While defoliation, the selected key parameter, is relatively easy to assess, it is of little help in cause-effect research – because of low specifity. Defoliation can occur for several reasons.

Cause-effect relationships are however now to be investigated through long-term observations and ecosystem analyses on permanent plots. Several countries have also started a coordinated program for soil analysis, the first results of which are expected to be available in 1995.

There are many signs pointing to airborne pollutants as an outstanding cause of forest damage in countries where atmospheric concentrations and depositions are exceeding the critical loads for their forest ecosystems. Air pollution is in fact, among a majority of the countries participating in the survey, considered to be a predisposing, accompanying, or triggering factor.

The spectre of global warming is also brought out as a future threat to the forests. The annual report on the survey mentions especially southern Europe, where drought is already causing damage in the form of stress as well as in an increased frequency of forest fires.

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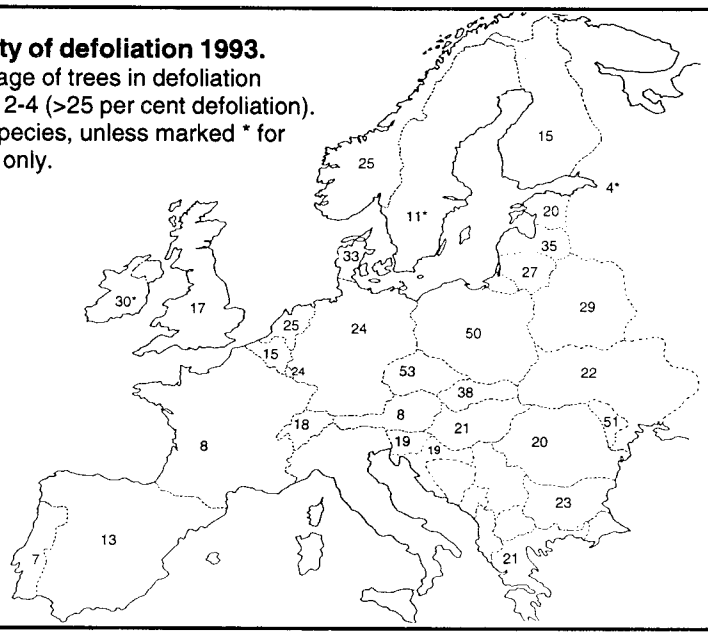
Forest Condition in Europe. Annual report of the forest-damage survey in Europe, prepared by the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests within the UN-ECE Convention on Long Range Transboundary Air Pollution, in cooperation with the Commission of European Communities.

Intensity of defoliation 1993.
Percentage of trees in defoliation Classes 2-4 (>25 per cent defoliation). For all species, unless marked * for conifers only.



Results from forest-damage surveys 1986-1993. Percentage of trees in Classes 2-4 (defoliation >25 per cent). All species.

	1986	1987	1988	1989	1990	1991	1992	1993
Austria	–	–	–	10.8	9.1	7.5	6.9	8.2
Belarus	–	–	–	67.2	54.0	–	19.2	29.3
Belgium	–	–	–	14.6	16.2	17.9	16.9	14.8
Bulgaria	8.1	3.6	7.4	24.9	29.1	21.8	23.1	23.2
Croatia	–	–	–	–	–	–	15.6	19.2
Czech Republic						–	56.4	53.0
Denmark	–	23.0	18.0	26.0	21.2	29.9	25.9	33.4
Estonia	–	–	9.0*	28.5*	20.0*	28.0*	28.5	20.3
Finland	–	12.1	16.1	18.0	17.3	16.0	14.5	15.2
France	8.3	9.7	6.9	5.6	7.3	7.1	8.0	8.3
Germany						25.2	26.0	24.2
- former East	–	–	13.8	16.4	35.9			
- former West	18.9	17.3	14.9	15.9	15.9			
Greece[3]	–	–	17.0	12.0	17.5	16.9	18.1	21.2
Hungary	–	–	7.5	12.7	21.7	19.6	21.5	21.0
Ireland	–	0.0*	4.8*	13.2*	5.4*	15.0*	15.7*	29.6*
Italy	–	–	–	–	–	16.4	18.2	–
Latvia	–	–	–	–	36.0	–	37.0	35.0
Lithuania	–	–	3.0	21.5	20.4	23.9	17.5	27.4
Liechtenstein	19.0	19.0	17.0	11.8	–	–	16.0	–
Luxembourg	5.1	7.9	10.3	12.3	–	20.8	20.4	23.8
Moldova	–	–	–	–	–	–	–	50.8
Netherlands	23.3	21.4	18.3	16.1	17.8	17.2	33.4	25.0
Norway	–	–	20.8*	14.8*	18.2	19.7	26.2	24.9
Poland	–	–	20.4	31.9	38.4	45.0	48.8	50.0
Portugal	–	–	1.3	9.1	30.7	29.6	22.5	7.3
Romania	–	–	–	–	–	9.7	16.7	20.5
Russian Fed.	–	–	–	–	–	4.2*	5.2*	4.5*[1]
Slovak Republic			38.8	49.2	41.5	28.5	36.0	37.6
Slovenia	–	–	–	22.6	18.2	15.9	–	19.0
Spain	–	–	4.5	4.2	4.8	7.4	12.3	13.0
Sweden	–	5.6*	12.3*	12.9*	16.1*	12.3*	16.9*	10.6*
Switzerland	12.0	15.0	12.0	14.0	17.0	21.0	16.0	18.0
Ukraine	–	–	–	–	–	6.4	16.3	21.5
United Kingdom	–	22.0	25.0	28.0	39.0	56.7	58.3	16.9[2]
Yugoslavia[4]	–	–	–	–	–	9.8	–	–

* Conifers only. [1] Data only from St.Petersburg region. [2] Change of assessment method in line with that used in other states. Based on previous standard the result was 54.0. [3] Excluding maquis. [4]Former Yugoslavia; Croatia and Slovenia excluded.

Recent publications

Sustainable development and the energy industries: Implementation and impacts of environmental legislation (1994)
Ed. by N. Steen. Proceedings from a workshop organized by the Energy and Environmental Programme of the Royal Institute of International Affairs. An examination of the interaction between environmental legislation and the energy industries: past experience; the challenges to the industries; actual and potential responses; and what this might imply for the framing of legislation.

330 pp. £15.95. Available from Earthscan Publications, 120 Pentonville Road, London, England SW1Y 4LE.

Power from plants: The global implications of new technologies for electricity from biomass (1994)
By W. Patterson. Report from the Energy and Environmental Programme of the Royal Institute of International Affairs. Describes the prospects for biomass power in its many forms worldwide, and analyses its possible implications.

102 pp. £9.95. Obtainable from Earthscan, address as above.

Transport in transition: Lessons from the history of energy (1994)
By S. Peake. Although national energy efficiency in the UK has improved by 30 per cent since 1970, national transport efficiency has dropped by nearly 20 per cent. Could the successful energy efficiency policies provide a fresh approach to coping with transport growth and its impacts? The idea is discussed in this report from the Energy and Environmental Programme of the Royal Institute of International Affairs.

128 pp. £12.95. Obtainable from Earthscan, address as above.

The environmental relations between the EC and the countries of Central and Eastern Europe (1993)
By A. Rubin and M. Kaspar. Describes and analyses the political and economic relations between the European Union and the countries of Central and Eastern Europe. The major assistance programs are described, as are the consequences of increased free trade between the two regions and possible scenarios for the future.

30 pp. Available from Euronatur, Koblenzerstrasse 9, 53359 Rheinbach, Germany.

DEFOLIATION

A reliable test

ASSESSING DEFOLIATION can be a reliable way of determining the state of forests' health, in the view of two Norwegian researchers writing in *Ambio*, the ecological magazine published by the Royal Swedish Academy of Sciences. But to find the extent to which air pollution is responsible for forest damage, the material must first be grouped according to climate, tree age, and productivity. These three factors have been found to account for 43 per cent of the variation in crown density in Norway spruce (*Picea abies*). It is easier, after the natural factors have been eliminated, to identify effects from other causes, say the researchers.

Source: **Isolation of natural factors affecting crown density and crown color in coniferous forest:implications for monitoring of forest decline**. By M.G. Thomsen and C. Nellemann, in Ambio Vol. 23, No. 4-5, July 1994.

... AND CRITICAL LOADS

A relationship found

BY CONCENTRATING on Norway spruce in the southern part of their country, where there is little variation in climate but a clear gradient in air pollution load, Norwegian researchers have found for the first time that when natural factors are eliminated, a clear connection can be seen between defoliation and the exceeding of critical loads for acid deposition.

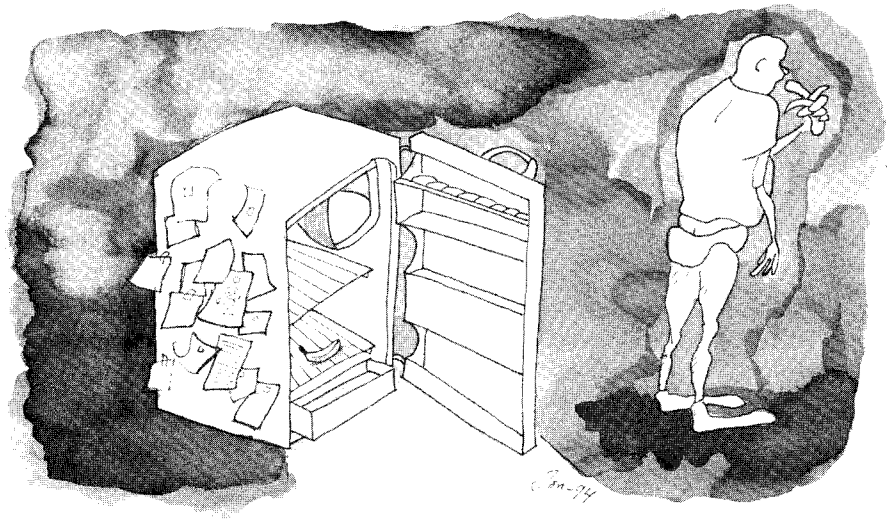
The natural factors were the age of the trees and the height at which they grew above sea level. By confining the study to trees more than seventy years old, variation in forest management practices could to some extent be avoided. Trees growing at more than 400 metres above sea level were also ignored, since there was known to be a relationship between higher altitude and defoliation.

The defoliation was found to be considerably greater in places where the deposition of acidic airborne pollutants exceeded the critical limits. There the soil was much poorer in base cations and phosphorus than in other sample areas where the trees were less damaged. There were no differences in soil depth which might have accounted for this.

Since the bedrock in Scandinavia is generally slow weathering, the critical limits for acidic deposition are nearly always very low. Although the deposition is only moderate compared with Central Europe, the limits for critical loads are being exceeded over wide areas – with a steady impoverishment of the soil as a result.

If the relationship that the Norwegians think they have found turns out to be correct, there will be every reason to expect further damage to the Scandinavian forests, if nothing is done to bring about a marked reduction of the acidic fallout.

Source: **Spatial patterns of spruce defoliation: relation to acid deposition, critical loads, and natural growth conditions in Norway**. By C. Nellemann and T. Frogner, in Ambio Vol. 23, No. 4-5, July 1994.



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APPLIANCES

Efficiency standards halted by controversy

APPLIANCE MAKERS are obstructing efforts to impose mandatory standards for energy efficiency in their wares. Many of their trade associations are refusing to cooperate even in a study of energy efficiency. An EU proposal for such standards for refrigerators has been held up for months, too, by a conflict within the European Commission.

When an informal draft for an EU Directive on refrigerators was released late last year, Greenpeace immediately contended that by setting the standards too low, the Commission was being too considerate of industry's demands (see AN 1/94, p.5). But even this draft was opposed by the Commission's Directorates for Industry and Competition, which echoed the manufacturers' argument that mandatory standards put too much restraint on competitiveness.

The confrontation over refrigerators has shed doubt on the Commission's possibilities of producing directives for other appliances. If so, the Commission would be faced with a further dilemma, since both the Netherlands and Denmark are threatening to introduce minimum standards for energy efficiency in domestic appliances if the EU fails to produce anything.

Previously the Group for Efficient Appliances, an advisory body of experts set up by the Commission itself, had reported difficulties in getting information on dishwashers, washing machines, and driers – due, it was said, to the refusal of trade associations to supply data. The GEA nevertheless maintains that minimum efficiency standards are by far the most cost-effective means of achieving efficiency targets. Eco-labelling, it says, has "very real limits," since consumer choice is guided largely by price and aesthetic values. As an optimum solution it would favour a combination of mandatory standards with a labelling scheme.

A GEA spokesman has also noted that it is by far the most important to have efficiency standards for refrigerators, since they account for such a high proportion of households' consumption of electricity – saying further that "If this directive does not go through, there will be little hope for any others."

Source: **ENDS Report** 235, August 1994.

Footnote. The Energy Saving Trust has estimated that refrigerating accounts for a good third of the electricity consumed by domestic appliances in Britain, noting too that the worst refrigerators on the market consume three times as much electricity as the most energy-effective ones.

CO_2 CREDITS

Scheme for international trade-off US-Europe

THREE AMERICAN power companies hope that by putting up money for the conversion of a coal-fired plant in the Czech Republic to natural gas, they will be credited for part of the emissions reduction as though it had been made in their own plants.

The three companies, NIPSCO Industries, Wisconsin Electric Power Company, and Edison Development Company, will contribute $200,000 each to the $1.5 million project at Decín, in northern Bohemia. Decín municipality will pay the rest, and the Czech Republic will transfer 40 per cent of the credits, earned from reducing the emissions, to the Americans. Along with the conversion of the Bynov plant to natural gas, measures will be taken to ensure a more efficient use of energy.

The resulting reductions are expected to amount to 12,800 tons of carbon dioxide a year. The cost of cutting down emissions at Decín is estimated to be no more than a third of what it would be if the Americans were to try and achieve the same results in their own plants.

The scheme is going ahead even though the United Nations, which administers the Climate Convention, has yet to set up a mechanism for trading pollution permits internationally. Nor has the US government decided whether cutting pollution abroad can be regarded as equivalent to a domestic reduction.

Probably the greatest gain for Decín will be the almost total elimination of sulphur-dioxide emissions from the Bynov plant. In consequence of the many coal-fired power plants, and peculiar geographical and meteorological conditions of the region, during long periods in winter the concentrations of sulphur dioxide in the air can be ten times higher than recommended in the WHO guidelines. Respiratory troubles are widespread, and child mortality in Decín is twice the national average.

Source: **New Scientist**, May 7, 1994.

BRIEFS

Killer smog

More people die from heart and lung diseases on smoggy days. The mortality patterns identified in a six-year study of air pollution in Paris point the same way as findings from the United States and Great Britain (AN 2/94, p.13, 4/94, p.5). The Regional Health Observatory for Paris reports categorically that health effects linked directly to smog are "sufficient to justify measures to control atmospheric pollution and the institution of preventative measures." The French study reveals an undeniable relation between disease and death rates and the concentrations of four pollutants: black smoke (a measure of particulate matter in the air), nitrogen dioxide, sulphur dioxide, and ozone.

New Scientist, October 15, 1994.

A better way

Ukraine is asking for aid in completing five Russian pressurized-water reactors, so as to enable it to shut down its Chernobyl plant. According to the US Department of Energy, electricity from those reactors would cost about 4 cent per kWh. But the department also says that increased efficiency in Ukrainian industry might be expected to reduce the demand for electricity by 4250 MW, and the cost would be only 1-2 cents per kWh. A further 2000 MW could be obtained from hydro and wind power, at a cost of 2-2.5 cents per kWh, and modernization of the country's fourteen coal-fired power stations could yield another 2000 MW. The department therefore concludes that completion of the five reactors would be inadvisable.

Ny Teknik, September 1, 1994.

Hard rain

Acid rain is the number one threat to the survival of key wild areas in England and Wales, according to a wide-ranging survey by Friends of the Earth. The unseen pollution from the skies threatens five times as many officially designated sites of special scientific interest as do the bulldozers that are ripping up the countryside for new roads.

More than 15 per cent of the SSSIs in England and Wales are said to face damage or destruction from pollution and development schemes. After acid rain the leading peril is eutrophication, followed by minerals extraction. In southeastern England road construction comes before mining in the top three.

New Scientist, October 8, 1994.

PHARE PROGRAM

At cross purposes

THE EUROPEAN COMMISSION'S PHARE program for aid to Central and Eastern Europe lacks any proper strategy for its long-term aims, say environmentalist organizations in the Czech Republic, Slovakia, and Hungary. Western consultants have sometimes been paid such high fees that there has been little left for environmental improvement. Also, coordination in some cases has been so poor that one project has damaged another.

As an example of this last defect the environmentalists quote the retrofitting of the coal-fired power plant at Prunerov, in northern Bohemia, for flue-gas desulphurization. The process requires enormous quantities of limestone, the quarrying of which is, apart from a general desecration of the environment, threatening some karst formations that would be especially worth preserving for their flora and fauna. At the same time 800,000 ecus has been expended in another PHARE project to determine how these areas might be protected. Now, because of PHARE support for the limestone method, the Czech government is planning to install similar equipment at seventeen other coal-burning plants.

The criticism of the PHARE program comes in a study made by the World Wide Fund for Nature in Hungary, Children of the Earth in the Czech Republic, and Tree of Life in Slovakia.

Source: **New Scientist**, April 9, 1994.

Letter to the Editor

SIR, We would like to comment on the digest of an article by John Vidal in the Guardian, which appeared in Acid News 3, June 1994. While we welcome efforts to show how cities can be made environmentally and humanly attractive, we cannot agree that Freiburg is especially deserving of such a reputation.

No mention is made for instance of the authorities' plan for a four-lane motorway running right through the centre of the city, which is meeting strong opposition from many of the people of Freiburg. This B 31 motorway is designed to be the most-used east-west arterial in southern Germany. If built, it will undoubtedly bring an enormous increase in heavy traffic passing through the city – and assuredly put a stop to Freiburg's "aim of becoming the most attractive city in Europe."

Another unpleasant aspect of local politics can be seen in the way car parking is being treated. While parking space certainly has been reduced in some areas, a huge parking garage has also been built in the city centre, thus attracting traffic rather than reducing it. Moreover there is still not enough accomodation for bicycles at places such as railway stations and the university. The demands of many environmentalist groups for roofed parking spaces for bicycles have also been ignored.

Nor are the city's energy politics as exemplary as Mr Vidal seems to have been led to believe. The heat-and-power scheme has not even been started, and will certainly not be ready by 1996. Although it has been talked about officially for many years, nothing has yet happened. Moreover the size of the projected plant has been steadily reduced. Whereas it was at first said that 90 per cent of Freiburg's demand for electricity would be met from environmentally friendly heat-and-power plants, the authorities now mention only 30 per cent.

Then again, the new suburb is far from turning out to be "environmentally advanced." The authorities have failed to take the opportunity, for instance, to prescribe energy-efficient buildings. Nor have they taken any notice of the desire of a group of citizens for a car-free suburb, such as is planned for the North Sea port of Bremen. Should a small car-free area nevertheless come about, it will only be as a result of massive pressure from environmentalist groups.

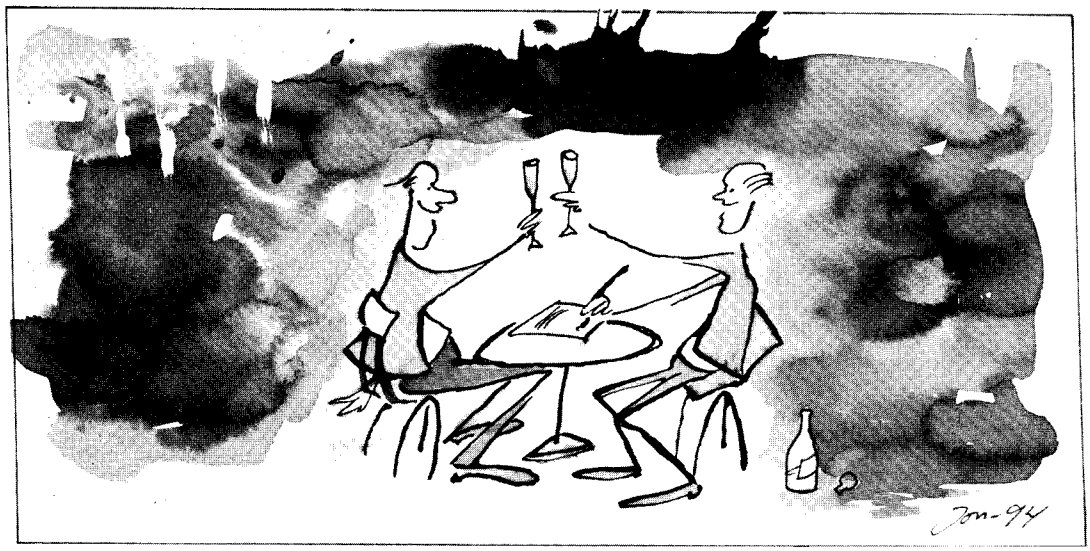
Altogether we would like to have it understood that almost everything that has been done so far to make Freiburg an attractive city, from the point of view of the environment in its broadest sense, is the result of pressure from environmentalist groups.

Bernward Janzing

Gero Lücking, Öko-Institut e.V. Freiburg

Ulrike Eberle and Stefan Auchter, Greenpeace Kontakgruppe Freiburg

Clean air program questioned



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A market system of tradeable allowances requires a great deal of cooperation.

LARGELY BECAUSE the acid-rain program of the Clean Air Act (1990) is about to start up, emissions of sulphur dioxide are currently a hot topic in the United States. The two-phase program, which is designed to cut emissions by 10 million tons by the year 2000, will commence on January 1, 1995. Limits will then become applicable for the 110 dirtiest utility units.

Opinion is divided as to whether the program, governed by the US Environmental Protection Agency (EPA), will succeed. Detractors have for instance faulted it for its ambiguous legislation and consequent loopholes. Frequently cited is the way utilities can be classified for either Phase I or Phase II plants. Phase I plants, which are the dirtiest, will have to meet program limits by 1995, while Phase II units will have until 2000 before needing to do so.

Some plant managers have already admitted that they intend to shift production loads from Phase I to Phase II installations, thereby delaying the need to reduce emissions until later, when reduction may be more cost-effective. In the view of many environmentalists, this goes against the intentions of the Clean Air Act.

Some critics question whether participants in the acid-rain program are really dedicated to reducing sulphur-dioxide emissions. Under the Clean Air Act the EPA is authorized to create a market system of tradeable allowances for SO_2 emissions that electric utilities could use. This will require a great deal of cooperation between utility companies, state public utility commissions (PUCs), state agencies for air-pollution control, and the EPA. But by the end of September, only in six states had the public utility commissions begun to address the issue of emission-allowance trading, and these were Pennsylvania, Ohio, Indiana, Wisconsin, Maryland, and Connecticut.

But many of those involved insist it is off to a good start

Many experts, environmental and economic, regard the trading of emission allowances, complicated though it is, as the only means of successfully meeting the requirements for reducing emissions of SO_2. Sceptics say that because of insufficient PUC guidance, many Phase I utilities will be hindered in their efforts to meet the deadlines for compliance.

Nevertheless, many of those involved in the acid-rain program insist that it is off to a good start. Representatives of electric utilities, environmentalist groups, and the EPA, testifying before the House Energy and Commerce Subcommittee on Energy and Power on October 5, 1994, were agreed that the program to reduce emissions of sulphur by 50 per cent from 1990 levels was on track. As Mary Nichols, assistant administrator for Air and Radiation, told the subcommittee, "Over one million allowances have already been traded and there has been increasing participation in the EPA auctions, signalling the development of a healthy allowance market." Echoing these sentiments, Joseph Goffman, senior attorney for the Environmental Defense Fund, said the program was exceeding expectations.

The EPA also expressed its intention of carrying control beyond the strict requirements of the Clean Air Act. Industries often use smokestack scrubbers to reduce emission levels, but the cleaning process is creating other problems when contaminated waste is released into water and landfills. Carol Browner, EPA head, promised to eliminate such deficiencies as a part of the effort to develop her new "Common Sense" approach to environmental regulation that was introduced in July, 1994.

Other suggestions for improving the acid-rain program that were made at the hearing included a proposal that there should be free public access to the EPA's databases of allowance transactions, and continuous monitoring of emissions to determine whether the required reductions were actually being made.

ALEXANDER TIGER

The writer is Project Coordinator at the Pacific Environment and Resources Center, Sausalito, California.

New figures presented

A YEAR AGO, in the December issue, we published data from the EMEP on emissions of sulphur and nitrogen oxides in Europe, covering the years from 1980 to 1992. The figures, which were then preliminary, have now been adjusted as in the adjoining tables. It now appears that during that period the emissions of sulphur were actually reduced by 37 per cent, not 30 as previously given. Those of nitrogen oxides, on the other hand, were found to have remained almost exactly the same, amounting to about 22 million tons both in 1980 and 1992.

The emission figures are based on data supplied by the countries participating in EMEP, the European Monitoring and Evaluation Programme, going back to 1977. The ones for sulphur are in general more reliable than those for nitrogen oxides.

The overall information is used – together with field measurements, meteorological data, and advanced computer models that depict the conversion and deposition of pollutants – to give a picture, year by year, of the transboundary movements of air pollutants across Europe. Since transports can be greatly affected by variations in weather and air currents, the values in the deposition tables are given as averages for 1992 and 1993.

The EMEP model also includes estimates (NAT) of the natural emissions of sulphur from the sea (production of dimethyl sulphide by phytoplankton). The emissions from ships plying in international trade are, as shown, from the Baltic and North Seas and parts of the Atlantic. No figures can be given for the Mediterranean and the Black Sea, despite the heavy traffic in those waters. All the data concerning shipping is in any case said to be incomplete, which means it probably amounts to an underestimate.

Not being attributable to any specific country, a considerable part of the depositions in western Europe have to be ascribed to indeterminate sources (IND). Two-thirds are nevertheless thought to emanate from within Europe, the rest being carried across the Atlantic by winds from North America.

These EMEP reports provide an important check on the way signatories to international agreements are fulfilling their obligations, as well as on the general effect of such agreements. The data in them is moreover required when negotiating agreements for further reductions of emissions under the UN ECE Convention on Long Range Transboundary Air Pollution.

CHRISTER ÅGREN

***Transboundary Acidifying Pollution in Europe: Calculated fields and budgets 1985-93.** EMEP MSC-W Report 1/94. Available from The Norwegian Meteorological Institute, P.O. Box 43-Blindern, N-0313 Oslo 3, Norway.

Emissions of sulphur and nitrogen oxides.

		Sulphur (1000 tons)		Nitrogen oxides (1000 tons as NO_2)	
		1980	1992	1980	1992
Albania	AL	[60]	[60]	[30]	[30]
Austria	AT	198	38	246	201
Belarus	BY	370	298*	244	263*
Belgium	BE	414	156	442	374
Bosnia & Herzegovina	BA	[102]	[100]	[45]	[52]
Bulgaria	BG	1025	560	416*	240
Croatia	HR	75	80*	[100]	[124]
Czech Republic	CS	1128	769	937	698
Denmark	DK	226	122*	273	310*
Estonia	EE	[138]	[90]	[66]	[64]
Finland	FI	291	97*	264	286*
France	FR	1674	604	1823	1810*
Germany[1]	DE	3746	2275*	3640	3140*
Greece	GR	200	255*	746*	746*
Hungary	HU	816	451*	273	211*
Iceland	IS	3	3*	13	12*
Ireland	IE	111	80	73	125
Italy	IT	1900	1090*	1480	1761*
Latvia	LV	[45]	[41]	[54]	[54]
Lithuania	LT	[68]	[68]	[56]	[56]
Luxembourg	LU	12	8*	23	19*
Macedonia[2]	FYM	[5]	[5]	[2]	[2]
Moldova	MD	[46]	[46]	[35]	[35]
Netherlands	NL	233	89	548	550
Norway	NO	71	20	186	217
Poland	PL	2050	1410	1500*	1130
Portugal	PT	133	142*	166	211*
Romania	RO	900	702*	[680]	[680]
Russia	RU	3580	2200	1734	2326
Slovakia	SK	350	187*	227*	224
Slovenia	SI	118	94	43	46
Spain	ES	1660	1158*	950	980*
Sweden	SE	254	51	424	385
Switzerland	CH	63	30	196	161
Turkey[3]	TR	430	177*	[175]	[175]
Ukraine	UA	1925	1188	1059*	830
United Kingdom	GB	2449	1782*	2365	2747*
Yugoslavia[4]	YU*	[350]	[335]	[160]	[196]
Rem. area (North Africa)[3]	REM	[256]	[256]	[100]	[100]
Int. trade, Baltic Sea	BAS	[36]	[36]	[80]	[80]
Int. trade, North Sea	NOS	[87]	[87]	[192]	[192]
Int. trade, rem. Atlantic	ATL	[158]	[158]	[349]	[349]
Int. trade, Mediter.[5]	MED	[6]	[6]	[13]	[13]
Int. trade, Black Sea	BLS	n o	d a t a		
Biogenic sea emissions	NAT	[362]	[362]	[0]	[0]
Sum		**28126**	**17815**	**22429**	**22205**

The table shows national official data received at the ECE secretariat. Data estimated by MSC-W/CCC are given in square brackets. * Interpolated data (no data have been officially submitted). [1] Incl. East Germany in 1980 figure. [2] Former Yugoslavian republic of Macedonia. [3] Part within the EMEP area of calculation. [4] Former Yugoslavia, excluding Slovenia, Croatia, Bosnia and Hercegovina, and Macedonia. [5] Data for the vicinity of Gibraltar only.

Provisional estimate of sulphur budget for Europe. Average for 1992-93. Total deposition of sulphur. Unit: 100 tons per year.

	AL	AT	BE	BG	DK	FI	FR	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	TR	GB	BY	UA	MD	RU	EE	LV	LT	SI	HR	BA	YU	FYM	CS	SK	REM	BAS	NOS	ATL	MED	NAT	IND	SUM
AL	100	0	0	26	0	0	2	6	13	6	0	0	20	0	0	0	4	0	8	1	0	0	1	1	0	4	0	0	0	0	0	1	2	5	22	2	3	1	1	0	0	0	0	1	54	290
AT	0	92	12	6	2	0	73	215	1	57	0	1	218	2	4	0	68	0	22	12	0	14	0	34	1	6	0	0	0	0	0	56	12	6	16	0	118	23	1	0	3	1	0	1	196	1289
BE	0	0	306	0	1	0	114	98	0	3	0	2	3	3	24	0	7	0	2	10	0	0	0	92	0	2	0	0	0	0	0	0	0	0	1	0	15	1	0	0	12	2	0	2	44	746
BG	8	2	2	1257	1	0	6	54	16	65	0	0	18	0	1	0	44	0	274	2	0	0	6	6	5	60	7	8	0	0	1	2	6	10	140	2	30	14	1	0	1	0	0	2	196	2254
DK	0	0	6	0	137	0	10	96	0	3	0	2	1	0	5	1	38	0	2	2	4	0	0	82	2	2	0	2	0	0	2	0	0	0	0	0	20	2	0	6	8	1	0	4	44	481
FI	0	1	5	2	15	276	9	118	0	9	0	1	2	0	4	4	95	0	7	2	22	0	0	48	25	25	1	286	54	12	12	0	0	0	2	0	26	5	0	13	4	1	0	8	306	1400
FR	0	6	137	2	5	0	1988	384	1	22	0	10	298	10	33	0	55	14	10	368	1	22	0	316	1	4	0	0	0	0	1	12	7	5	11	0	67	9	8	1	42	30	0	27	652	4580
DE	0	17	196	6	44	0	472	7440	0	58	0	10	138	16	110	0	347	4	28	63	2	24	0	507	4	20	1	6	1	1	3	13	6	4	12	0	816	34	1	8	52	10	0	15	594	11038
GR	30	1	1	264	0	0	5	30	400	26	0	0	33	0	0	0	20	0	67	2	0	0	22	3	2	30	2	4	0	0	0	2	4	8	66	2	14	5	4	0	0	0	0	4	234	1296
HU	1	14	5	16	2	0	20	145	2	1126	0	0	52	0	2	0	125	0	114	5	0	2	0	15	3	22	2	2	0	0	1	20	33	20	84	0	108	103	1	0	2	0	0	1	144	2205
IS	0	0	0	0	0	0	0	3	0	0	4	0	0	0	0	0	1	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	10	30	62
IE	0	0	2	0	0	0	6	10	0	0	0	132	0	0	1	0	2	0	0	8	0	0	0	124	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	2	8	0	13	56	370
IT	4	11	6	28	2	0	121	122	12	60	0	1	2984	1	3	0	68	3	25	73	0	22	3	27	2	10	1	2	0	0	0	58	36	32	42	0	52	16	22	0	2	2	0	10	568	4440
LU	0	0	2	0	0	0	10	6	0	0	0	0	0	13	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	40
NL	0	0	76	0	2	0	62	200	0	4	0	2	2	1	138	0	16	0	2	6	0	0	0	226	0	2	0	0	0	0	0	0	0	0	0	0	31	2	0	0	20	2	0	3	53	799
NO	0	0	10	0	27	8	16	123	0	8	0	6	1	0	8	46	48	0	4	8	16	0	0	176	6	6	0	76	4	2	3	0	0	0	2	0	27	3	0	4	14	5	0	26	352	1056
PL	1	10	40	10	44	3	86	2263	2	155	0	4	37	2	24	2	4767	1	70	18	7	4	0	205	35	108	4	36	4	4	17	11	8	6	33	0	732	122	1	14	16	3	0	8	514	9416
PT	0	0	0	0	0	0	4	2	0	0	0	0	2	0	0	0	0	309	0	122	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	17	0	5	62	532
RO	6	6	6	134	2	0	22	192	10	313	0	0	46	0	4	0	206	0	2322	5	0	1	4	20	14	190	22	20	1	1	3	10	18	19	223	1	116	84	1	1	2	0	0	2	376	4418
ES	0	0	11	2	1	0	101	44	1	8	0	2	45	0	4	0	10	123	4	3206	0	2	0	45	0	0	0	0	0	0	0	3	2	2	4	0	5	1	20	0	4	32	2	17	413	4127
SE	0	1	18	1	100	37	30	302	0	14	0	4	2	0	13	18	160	0	13	5	136	0	0	183	17	18	1	70	14	8	11	1	1	1	6	0	62	10	0	24	17	4	0	20	426	1746
CH	0	2	4	1	1	0	78	44	0	4	0	1	208	0	2	0	8	0	2	18	0	82	0	18	0	0	0	0	0	0	0	4	2	2	3	0	9	1	1	0	2	1	0	1	108	612
TR	6	2	2	198	2	0	9	66	78	40	0	0	24	0	1	0	58	0	126	3	0	0	556	8	10	133	8	26	2	1	2	2	4	4	38	0	36	11	3	0	1	0	0	7	858	2324
GB	0	1	35	0	6	0	84	166	0	4	0	48	4	1	22	1	35	2	2	22	1	0	0	4983	1	3	0	2	0	0	0	0	0	0	0	0	40	3	0	1	49	24	0	34	216	5794
BY	0	2	6	12	14	6	16	208	1	46	0	1	14	0	4	1	366	0	55	6	4	1	2	50	850	155	6	97	12	17	46	4	3	3	14	0	78	20	0	6	4	1	0	2	334	2467
UA	3	6	16	102	14	6	38	529	10	236	0	2	44	1	10	1	832	0	408	8	4	2	16	80	196	4110	70	290	10	9	24	11	14	12	70	0	214	125	1	6	7	2	0	6	1022	8573
MD	0	0	1	11	0	0	2	32	0	19	0	0	4	0	0	0	44	0	82	0	0	0	0	3	5	78	88	6	0	0	1	1	1	1	8	0	16	9	0	0	0	0	0	0	56	471
RU	4	7	26	136	64	172	64	754	17	174	0	6	44	1	19	8	924	1	310	18	38	2	56	240	698	2172	39	10269	260	79	105	10	12	12	75	0	276	80	0	36	18	5	0	26	6716	23947
EE	0	0	1	0	4	11	2	35	0	2	0	0	0	0	0	0	27	0	2	0	2	0	0	10	8	6	0	17	127	8	5	0	0	0	0	0	6	1	0	4	1	0	0	1	49	338
LV	0	0	2	2	6	6	4	66	0	5	0	0	2	0	2	0	64	0	5	1	4	0	0	22	28	14	1	24	12	75	23	0	0	0	2	0	14	2	0	5	2	0	0	2	87	488
LT	0	0	4	2	6	3	7	100	0	10	0	1	2	0	2	0	138	0	10	2	3	0	0	28	26	20	1	26	4	13	162	0	0	0	3	0	22	4	0	4	2	0	0	2	102	724
SI	0	7	1	2	0	0	9	32	0	21	0	0	78	0	1	0	18	0	8	4	0	1	0	4	0	2	0	0	0	0	0	209	24	14	10	0	17	5	1	0	0	0	0	0	58	530
HR	2	6	2	8	1	0	12	58	2	68	0	0	104	0	1	0	41	0	16	6	0	1	0	6	1	6	0	0	0	0	0	20	182	60	40	0	36	13	2	0	1	0	0	1	110	810
BA	3	3	2	10	1	0	8	49	2	54	0	0	65	0	1	0	34	0	17	4	0	0	0	6	1	6	0	0	0	0	0	6	32	233	60	0	24	12	2	0	1	0	0	1	108	752
YU	20	4	2	78	1	0	10	82	10	130	0	0	62	0	2	0	46	0	87	4	0	1	2	9	2	16	2	2	0	0	0	7	21	54	1032	2	42	20	2	0	1	0	0	2	190	1954
FYM	14	0	0	42	0	0	1	8	8	20	0	0	8	0	0	0	5	0	15	0	0	0	1	1	0	4	0	1	0	0	0	1	2	4	39	10	3	1	0	0	0	0	0	0	42	224
CS	1	12	15	4	4	0	48	787	1	64	0	1	28	1	7	0	251	0	26	9	1	3	0	38	3	13	1	2	1	1	1	7	4	2	14	0	1876	44	0	1	4	1	0	1	140	3416
SK	1	8	3	7	1	0	13	142	2	198	0	0	19	0	2	0	178	0	48	3	0	1	1	13	3	23	1	2	0	0	1	6	6	4	24	0	139	412	0	0	1	0	0	1	87	1352
REM	2	0	3	12	0	0	34	22	14	8	0	0	95	0	2	0	9	4	6	98	0	2	4	12	0	4	0	0	0	0	0	2	3	3	8	0	5	1	646	0	1	2	1	14	648	1672
BAS	0	2	32	4	268	113	60	809	0	32	0	6	8	1	24	8	584	1	26	12	86	1	0	288	42	46	2	194	110	50	46	2	2	2	12	0	150	23	0	120	26	4	0	27	491	3662
NOS	0	2	160	1	126	4	354	838	0	18	0	52	14	2	196	22	198	4	9	54	16	1	0	3685	8	15	0	14	4	2	6	2	2	2	4	0	179	12	0	12	306	38	0	147	683	7174
ATL	0	3	72	2	45	48	402	526	0	22	12	310	36	3	40	30	181	290	14	1806	22	4	0	1934	26	36	1	843	24	8	10	4	2	2	5	0	121	12	3	10	70	688	0	1476	4350	13490
MED	130	14	20	434	6	1	334	302	734	182	0	3	2304	2	9	0	190	22	214	942	1	13	166	84	12	115	10	20	1	1	3	48	90	106	232	3	134	47	382	2	8	11	2	140	2399	9886
BLS	4	3	6	417	4	2	16	168	30	84	0	0	24	0	3	0	182	0	344	4	2	1	150	20	34	579	34	108	3	2	6	4	8	8	64	0	82	30	1	2	2	0	0	18	836	3276

Estimate of oxidized nitrogen budget for Europe. Average for 1992-93. Total deposition. Unit: 100 tons nitrogen per year.

	AL	AT	BE	BG	DK	FI	FR	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	TR	GB	BY	UA	MD	RU	EE	LV	LT	SI	HR	BA	YU	FYM	CS	SK	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM
AL	3	1	0	4	0	0	2	4	20	1	0	0	14	0	0	0	2	0	3	1	0	0	0	1	0	1	0	0	0	0	0	0	2	1	4	0	1	1	0	0	0	0	0	0	0	18	87
AT	0	30	13	2	2	0	89	170	2	7	0	0	119	1	14	0	18	0	10	6	2	21	0	32	1	2	0	0	0	0	0	4	6	1	4	0	29	5	0	0	4	2	0	0	0	74	676
BE	0	1	36	0	1	0	67	73	0	0	0	1	2	1	26	0	2	1	0	5	0	1	0	68	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	0	8	2	0	0	0	20	324
BG	1	4	2	42	1	0	7	28	24	11	0	0	13	0	3	0	14	0	62	0	0	0	2	5	2	16	2	6	0	0	0	1	3	2	20	0	12	7	0	0	1	0	0	0	0	56	349
DK	0	0	6	0	22	0	12	48	0	0	0	2	1	0	12	3	13	0	0	2	5	0	0	62	2	2	0	0	0	0	0	0	0	0	0	0	8	2	0	2	6	2	0	0	0	20	230
FI	0	2	8	0	24	103	17	94	0	2	0	1	2	0	16	18	43	0	3	2	65	0	0	54	11	10	0	44	14	6	4	0	0	0	0	0	15	3	0	12	6	1	0	0	0	114	696
FR	0	10	84	0	6	0	844	334	2	4	0	8	157	6	66	2	19	16	4	138	2	28	0	258	1	1	0	0	0	0	0	2	4	1	3	0	28	5	2	1	30	34	0	0	0	262	2364
DE	0	28	154	0	30	2	470	1428	2	12	0	10	96	10	208	6	94	4	12	32	9	39	0	406	4	7	0	2	0	0	2	3	5	0	4	0	208	17	0	5	41	12	0	0	0	250	3584
GR	4	3	1	26	1	0	8	18	127	5	0	0	26	0	1	0	8	0	25	1	0	1	7	3	1	12	1	6	0	0	0	1	4	2	13	0	6	3	1	0	0	0	0	0	0	79	393
HU	0	19	6	4	2	0	24	80	4	43	0	0	42	0	8	0	36	0	32	2	1	4	0	14	2	7	0	2	0	0	0	4	14	3	14	0	35	28	0	0	2	0	0	0	0	51	485
IS	0	0	0	0	0	0	2	2	0	0	2	0	0	0	1	1	1	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	24	44
IE	0	0	3	0	0	0	14	11	0	0	0	20	0	0	4	0	1	1	0	5	0	0	0	64	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	8	0	0	0	30	165
IT	1	16	8	6	2	0	153	86	18	10	0	1	638	1	8	0	22	2	12	29	2	25	1	24	1	4	0	2	0	0	0	6	18	6	10	0	18	7	4	0	2	3	0	0	0	208	1354
LU	0	0	1	0	0	0	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	20
NL	0	0	32	0	2	0	46	111	0	0	0	2	2	0	62	1	6	0	0	3	1	0	0	116	0	0	0	0	0	0	0	0	0	0	0	0	11	1	0	0	10	2	0	0	0	24	436
NO	0	2	14	0	30	11	28	109	0	2	0	6	1	0	28	58	21	0	2	3	42	0	0	184	3	3	0	7	2	2	2	0	0	0	0	0	14	2	0	5	14	5	0	0	0	149	751
PL	0	19	47	2	43	4	118	630	4	26	0	4	34	2	76	8	447	2	26	9	22	9	0	184	20	30	2	16	1	2	4	3	6	1	8	0	200	46	0	10	18	4	0	0	0	196	2274
PT	0	0	0	0	0	0	6	2	0	0	0	0	1	0	0	0	0	44	0	48	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	40	160
RO	1	11	8	20	2	1	25	94	16	43	0	0	34	0	10	1	60	0	206	2	2	2	2	18	6	43	4	14	0	0	1	2	9	4	30	0	41	34	0	1	2	0	0	0	0	114	872
ES	0	2	11	1	2	0	110	46	2	2	0	2	34	0	12	0	4	84	3	356	0	4	0	42	0	0	0	0	0	0	0	0	2	0	2	0	3	0	4	0	4	30	2	0	0	187	958
SE	0	2	24	0	76	42	45	200	0	4	0	4	2	1	44	50	62	0	7	2	135	1	0	171	10	9	0	20	6	5	4	0	1	0	2	0	30	7	0	16	18	4	0	0	0	166	1171
CH	0	2	5	0	0	0	82	38	1	0	0	0	80	0	4	0	2	1	0	8	0	28	0	16	0	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	2	2	0	0	0	38	318
TR	2	4	4	22	2	1	14	46	85	8	0	0	20	0	4	0	23	0	49	2	2	1	82	8	5	47	2	28	0	0	1	1	3	1	9	0	18	6	1	0	1	0	0	0	0	297	802
GB	0	2	27	0	6	0	92	126	0	2	0	28	2	1	44	4	15	2	1	12	4	1	0	790	1	1	0	0	0	0	0	0	0	0	0	0	20	2	0	1	26	21	0	0	0	106	1340
BY	0	0	8	3	18	8	24	104	2	9	0	1	14	0	14	4	108	0	22	2	16	3	0	43	64	44	2	46	4	6	10	1	2	0	4	0	31	9	0	6	4	1	0	0	0	103	748
UA	1	14	20	20	19	10	54	247	20	40	0	2	41	1	32	4	254	0	120	4	16	6	8	79	60	386	14	164	8	6	8	3	10	3	18	0	86	53	0	6	8	2	0	0	0	328	2173
MD	0	1	1	2	1	0	3	14	2	3	0	0	2	0	2	0	13	0	13	0	0	0	0	4	2	16	2	4	0	0	0	0	1	0	2	0	5	4	0	0	0	0	0	0	0	17	116
RU	1	21	47	30	100	205	108	462	28	43	0	6	45	1	67	44	374	1	155	11	150	9	27	222	210	614	14	2349	58	42	38	4	12	4	25	0	137	52	0	38	22	6	0	0	0	2147	7908
EE	0	0	2	0	4	6	4	20	0	0	0	0	0	0	2	2	10	0	1	0	8	0	0	10	2	2	0	6	4	2	1	0	0	0	0	0	3	0	0	2	1	0	0	0	0	16	113
LV	0	1	2	0	9	6	7	33	0	1	0	0	1	0	5	2	21	0	2	1	10	0	0	19	7	4	0	10	2	6	4	0	0	0	0	0	6	1	0	4	2	0	0	0	0	27	198
LT	0	2	4	0	12	4	11	52	1	2	0	1	2	0	8	2	40	0	4	2	11	1	0	28	10	6	0	9	2	4	8	0	0	0	1	0	9	3	0	4	2	1	0	0	0	34	280
SI	0	7	2	0	0	0	11	22	1	2	0	0	48	0	2	0	6	0	4	2	0	2	0	3	0	0	0	0	0	0	0	4	6	1	2	0	5	1	0	0	0	0	0	0	0	20	156
HR	0	8	2	2	1	0	14	36	3	9	0	0	70	0	3	0	14	0	6	2	1	2	0	6	1	2	0	0	0	0	0	4	16	4	6	0	12	5	0	0	1	0	0	0	0	37	270
BA	1	6	2	2	1	0	11	31	4	8	0	0	55	0	2	0	12	0	7	2	1	2	0	6	1	2	0	0	0	0	0	12	12	8	10	0	9	5	0	0	1	0	0	0	0	38	243
YU	3	8	3	12	1	0	14	50	16	18	0	0	49	0	5	0	16	0	29	2	1	2	0	8	1	5	0	2	0	0	0	2	11	8	55	0	17	9	0	0	1	0	0	0	0	60	414
FYM	1	1	0	6	0	0	2	4	12	2	0	0	6	0	0	0	2	0	5	0	0	0	0	1	0	2	0	0	0	0	0	0	1	1	6	0	1	1	0	0	0	0	0	0	0	12	69
CS	0	15	17	1	4	1	59	242	2	11	0	1	23	1	21	1	44	0	11	6	3	8	0	37	1	4	0	1	0	0	0	1	3	1	3	0	120	14	0	1	4	1	0	0	0	57	722
SK	0	10	4	2	1	0	17	68	3	20	0	0	17	0	7	0	38	0	16	2	1	3	0	12	1	7	0	2	0	0	0	1	3	1	5	0	37	28	0	0	1	0	0	0	0	32	341
REM	0	2	4	2	1	0	56	29	18	2	0	0	74	0	8	0	4	3	4	34	0	4	2	12	0	2	0	0	0	0	0	1	3	1	3	0	3	1	39	0	1	2	1	0	0	414	732
BAS	0	6	34	1	103	50	78	360	0	6	0	6	7	2	64	24	134	2	11	6	104	2	0	218	17	14	0	32	11	9	8	1	2	0	2	0	56	12	0	26	22	5	0	0	0	166	1596
NOS	0	6	88	0	62	4	252	454	0	4	1	36	10	2	177	36	63	4	4	28	29	3	0	1234	6	6	0	6	2	2	2	0	2	0	0	0	62	7	0	8	88	34	0	0	0	280	2982
ATL	0	8	84	0	64	61	402	474	0	5	10	108	22	3	130	115	78	79	6	424	72	7	0	1236	13	14	0	108	8	5	4	1	2	0	2	0	65	8	0	12	70	288	0	0	0	2296	6280
MED	11	24	22	49	6	1	338	199	342	28	0	2	765	2	24	2	58	13	73	150	4	24	42	66	6	39	3	18	0	1	1	9	38	16	44	0	45	22	33	1	6	10	1	0	0	859	3403
BLS	1	6	6	25	5	3	19	75	33	14	0	0	20	0	8	2	54	0	88	2	4	2	30	16	11	118	6	88	1	2	2	1	5	2	14	0	33	14	0	2	2	0	0	0	0	230	940

Explanation of the tables

For two-letter country codes, see opposite table. To find the contribution from other countries to a certain country, follow the horizontal row starting from the relevant country code on the far left. To find the contributions from a certain country to other countries, follow the vertical column starting from the relevant country code at the top. REM signifies contribution to and from the part of the domain for deposition calculations which is not covered by European countries. IND signifies the part of the calculated depositions which cannot be attributed to any known emission sources by the present models.

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CARS

The greenest models

THE MOST environmentally friendly car on the roads in Europe is, according to two separate surveys published by the Environmental Transport Organization in Britain and the Verkehrsclub Deutschland, the Fiat Cinquecento, with an engine volume of just 0.9 litres.

The two organizations use similar criteria: engine size and power, fuel consumption in urban driving and at 90 kph, top speed, and noise. The Verkehrsclub Deutschland also takes account of the possibilities of recycling, and the measures for protecting the environment that have been taken during production. Of a typical car's effect on the environment during its whole lifetime, about 25 per cent is estimated to occur during the production stages.

Both organizations warn of uncertainties in the rankings. For one thing they are based on the manufacturers' own information, and for another no account has been taken of the tailpipe emissions, since the actual emissions for the various models were unknown – the results of type-approval test being regarded as unrepresentative for mass-produced vehicles.

The surveys show that the smaller and less powerful a car is, the better. The Cinquecento comes out top in both rankings, and two other small Fiats, the Uno and the Panda, feature among the top five in each list. In the top ten of each ranking are also found the Ford Fiesta and the Volkswagen Polo.

Source: **Environment Watch: Western Europe**, September 16, 1994.

CATALYZERS

Cleaning failures

AFTER FIVE YEARS' USE, the catalyzers on up to 15 per cent of the vehicles in some car models have been found to be underperforming. Ford is the make that comes out worst, according to the latest Swedish tests.

From the 1989 year models onwards, all new cars have been forced, because of stricter standards, to have catalytic converters. The car manufacturer is required by law to guarantee the proper function of the catalyzer for five years or 80,000 kilometres of driving. After that the car owner has to pay for putting it right.

Now there is a whole generation of used cars on the market with elapsed catalyzer warranties, and warnings about some models have begun to appear in the newspapers' consumer pages. In the yearly check on exhaust emissions, the following ten among the 1989 year models had the greatest number of failures:

	Per cent failed
1. Peugeot 405 Break	15.0
2. Fiat Croma	12.7
3. Ford Sierra 2.9	10.4
4. Ford Sierra 2.0	9.1
4. Ford Sierra Combi	9.1
6. Ford Escort Combi	9.0
6. Ford Scorpio 2.9	9.0
6. Peugeot 405	9.0
9. Mitsubishi Lancer Combi	8.9
10. Peugeot 309	7.7

The owners of cars with catalyzers that fail to pass the test after the warranty has run out will find it costing them 2000 to 10,000 kronor for a new catalyzer.

Models that came through the emissions test with flying colours were the Saab 900 i 16 3d, the Subaru Trendy, Toyota Celica, and Volvo 240 GL and 740 GLT.

Dagens Nyheter, September 10, 1994.

Coming events

Action Day: February 11, 1995
To coincide with the meeting of the International Negotiating Committe (INC) of the Climate Convention, environmentalist NGOs are to organize Action Days highlighting aspects of the climate problem.

Inquiries: A SEED EUROPE, P.O. Box 92066, NL-1090 AB Amsterdam, the Netherlands. Fax +31-20 665 01 66.

Climate Forum '95
At the time of the Conference of the Parties (COP) to the Climate Convention in Berlin, March 28 to April 7, environmentalist NGOs will be staging various events, exhibitions, and seminars with relevance to the agenda of the official summit.

Inquiries: Climate Forum Coordination Bureau, Behrenstrasse 23, D-10117 Berlin, Germany. Tel. +49-30 202 20 30.

10th World Clean Air Congress. Espoo, Finland, May 28-June 2, 1995.
Convened by the International Union of Air Pollution Prevention and Environmental Protection Associations (IUAPPA). Theme: "Growing challenges – from local to global." Complementing the conference will be excursions and exhibitions.

Inquiries: Merja Tolvanen, P.O. Box 57, 02151 Espoo, Finland. Fax +358-0-4567022.

Acid Reign '95? 5th International Conference on Acidic Deposition. Gothenburg, Sweden, June 26-30, 1995.
Focus will be on recent findings in regard to the origins and effects of acidic deposition and the various measures that have been taken to counteract them – especial importance being attached to the use of the critical-load and other effect-oriented concepts for developing abatement strategies. Program will include, besides plenary and poster sessions, visits to various demonstration sites and experimental plots relevant to the subject of the conference – immediately preceding which there will be a three-day excursion to Czech Republic and southwestern Poland.

Inquiries: Gainmore AB, Conference & Exhibition Services, St. Badhusg. 18-20, S-411 21 Göteborg, Sweden.